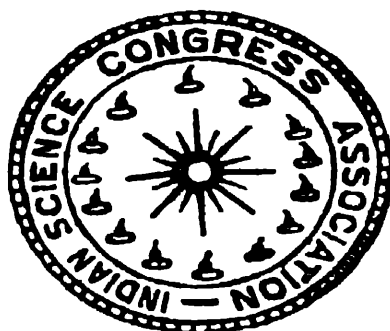


INDIAN SCIENCE CONGRESS ASSOCIATION

(REGISTERED UNDER ACT XXI OF 1880)

PROCEEDINGS OF THE FORTY-SECOND SESSION BARODA-1955

PART IV LATE ABSTRACTS, DISCUSSIONS, LIST OF MEMBERS AND INDEX



1, Park Street, Calcutta - 16.

PROCEEDINGS

OF THE

FORTY-SECOND

INDIAN SCIENCE CONGRESS

BARODA, 1955

PART IV

CONTENTS

	PAGE
1. LATE ABSTRACTS	
Section I. Mathematics	1
„ II. Statistics	2
„ III. Physics	3
„ IV. Chemistry	6
„ V. Geology and Geography	7
„ VII. Zoology and Entomology	10
„ VIII. Anthropology and Archaeology	12
„ X. Agricultural Sciences	15
„ XI. Physiology	18
„ XIII. Engineering and Metallurgy	19
2. DISCUSSIONS	
Transforms and their Applications	21
Non-Linear Vibrations	23
Absolute Summability of Series	24
Teaching of Mathematics in Engineering Institutions	28
Problems of Co-ordination of Statistical Activities	33
Demographic Problems	36
Statistical Method in Genetics and Plant Breeding	38
Molecular Spectra and Molecular Structure	44
Nuclear Structure	46
Modern Trends in Analytical Chemistry	51
Textile Chemistry	61
Synthesis of Steroids	68
Evolution of Continents	72
Natural Regions of India	73
Effect of Growth Promoting Substances on Crop Production	74

	PAGE
Applied Ecology	81
Structural Physiology of the Cytoplasm	88
Mechanism of Gastrulation	93
Tribal Welfare and Rehabilitation	96
Minerals in Soils and Clays	101
Plant Breeding Methods in Relation to Physiological and Biochemical Characters	102
Plant Introduction as an aid to improvement of Food and Fodder	108
Teaching of Agriculture	114
Teaching of Physiology in India	122
Interrelation of Protein and Vitamins	127
Psychological Research in India--Its Past, Present and Future	130
Crime and Society	134
Science and Its Social Relations	136

APPENDIX

3. LIST OF MEMBERS

4. INDEX ... 103

PROCEEDINGS OF THE FORTY-SECOND INDIAN SCIENCE CONGRESS BARODA 1955

PART IV

LATE ABSTRACTS

Section I, Mathematics.

31. On p -variations of Functions.

T. P. SRINIVASAN

Let f be a real valued function on the real line R^1 and let $\{a, b\}$ be any interval. Let $a = x_0 < x_1 < x_2 \dots < x_n = b$ be any partition of $\{a, b\}$ and let $V\{a, b\}$ denote the supremum of the sums $\sum_{i=1}^n |f(x_i) - f(x_{i-1})|$ taken over all partitions of $\{a, b\}$.

Then $V\{a, b\}$ is called the *variation* of f on $\{a, b\}$, and f is said to be of *bounded variation* on $\{a, b\}$ if $V\{a, b\} < \infty$. It is known that

(1) f is of bounded variation on $\{a, b\}$ if and only if it is the difference of two monotone functions;

(2) interpreting $V\{a, b\}$ as a set function on the class of all left-open, right-closed intervals $(a, b]$, it can be extended to a finitely additive measure μ on the ring of all finite disjoint unions of half-open intervals $(a, b]$, and

(3) μ is actually countably additive in the case of a "normalised" function f .

By slightly modifying the definition of $V\{a, b\}$ and replacing the absolute value of the difference $(f(x_i) - f(x_{i-1}))$ by its p^{th} power ($p \geq 1$), Wiener has defined the p^{th} variation of f for $p \geq 1$, denoted by $V^p\{a, b\}$ such that $V^1\{a, b\} = V\{a, b\}$. He has further shown that if $V^p\{a, b\} < \infty$, then f is continuous on $\{a, b\}$ if and only if $V^{p+1}\{a, b\} = 0$. In this paper these results are generalized for functions in R^n , the Euclidean space of dimension n .

32. On the equations of the structure for the projective and conformal geometry.

B. V. SINGBAL.

Let μ be an n -dimensional ϵ^3 manifold. Let $P_n = SL_{n+1}$ be the projective group of n variables = special linear groups of $n+1$ variables, S_n be linear group in n variables which takes the n dimensional sphere S^n onto itself taking great circles

into themselves. Let $E(\mu, P_n, P_n)$ resp. $E(\mu, S_n, S_n)$ be principal fibre spaces with μ as base space and P_n resp. S_n as fibre acting on itself by left translations.

Theorem 1. If a projective connexion is defined on μ then there exist $(n+1)^2$ linear differential forms w_{ij} defined on $E(\mu, P_n, P_n)$ satisfying

$$dw_{ij} = -\sum_{k=1}^{n+1} w_{ik} \alpha / w_{kj} + \Omega_{ij}, \quad \begin{matrix} i=1, \dots, n+1 \\ j=1, \dots, n+1 \end{matrix}$$

$$\sum w_{ii} = 0.$$

where Ω_{ij} is the curvature matrix.

Theorem 2. If a conformal connexion is defined on μ then there exist n^2+1 linear differential forms w_{ij} ; $i=1, \dots, n$; $j=1, \dots, n$ and satisfying

$$dw_{ij} = -\sum_{k=1}^n w_{ik} \alpha / w_{kj} + \Omega_{ij} \quad \begin{matrix} i=1, \dots, n \\ j=1, \dots, n \end{matrix}$$

$$w_{ij} = -w_{ji}$$

and $dw = 0$.

It is believed that the equations in Theorem 2 are new.

Section II, Statistics.

30. The Physical Significance of the Growth constants of the Skew Logistic Elongation Curve of Sugarcane Crop.

P. S. SREENIVASAN and P. S. NAYER.

The elongation curve of a field crop is sigmoid in shape and skew logistic or the 'growth curve' of the form

$$y = d + k / (1 + e^{a_0 + a_1 x + a_2 x^2 + a_3 x^3})$$

was found to be most appropriate. A series of such curves have been fitted in the past to the elongation data of sugarcane crop grown at Poona. In the present paper, a normal elongation curve for the P.O.J. 2878 variety of sugarcane has been generated and the main characteristic of such a curve is briefly indicated. Also the range of variation of the various constants of the skew logistic curve along with the physical significance of any change in these constants has been brought out by graphical methods.

31. The Spurt in the Expectation of Life in Mysore State.

T. CHANDRASEKHARAIYA, Mysore and
E. R. SUNDARARAJAN, Bangalore.

This paper discusses the various problems relating to the birth and death statistics of the Mysore State. Adjustment for the incompleteness of the data has been suggested and Life Table for the State for 1953 has been constructed.

32. On the Testing of outlying Observation.

A. KUDO, Calcutta.

Let $X_1^{(i)}$ ($i=1, 2, \dots, N_1$) be distributed in $N(m_1, \sigma^2)$ respectively, $X_1^{(a)}$ ($i=1, 2, \dots, N_2, N_2 \geq 0$) in $N(m, \sigma^2)$ and $X_1^{(s)}$ ($i=1, 2, \dots, N_3, N_3 \geq 0$). Our null hypothesis is $H_0(m_1=m_2=\dots=m_{N_1}=m)$ where m is free. We have N_1+1 alternative hypothesis $H_1(m_1=m_2=\dots=m_{j-1}=m_1-\Delta=m_{j+1}=\dots=m_{N_1}$,

Late Abstracts: Section of Physics

$\Delta > 0$). Our problem is to find out a suitable decision procedure as to these ~~order~~ decisions. 70

Let

$$\begin{aligned} \mathbf{x}_M &= M_{\mathbf{a}\mathbf{x}} \mathbf{X}_i^{(1)}, \\ i &= 1, 2, \dots, N_1 \\ \mathbf{x} &= (\Sigma \mathbf{X}_i^{(1)} + \Sigma \mathbf{X}_i^{(2)}) / N_1 + N_2 \\ s^2 &= \Sigma (\mathbf{X}_i^{(1)} - \mathbf{x})^2 + \Sigma (\mathbf{X}_i^{(2)} - \mathbf{x})^2 + \Sigma \left(\mathbf{X}_i^{(3)} - \frac{\Sigma \mathbf{X}_i^{(3)}}{N_3} \right)^2 \end{aligned}$$

The decision procedure: if $(\mathbf{x}_M - \mathbf{x})/s \geq \lambda$, select H_M otherwise select H_0 , is found to be optimum in the following sense. This maximizes the probability of making correct decision when H_1 is true among the decision procedures which are invariant under the change of scale and location parameters and whose probability of making correct decision when H_1 is correct does not depend on i but only on Δ/σ and the same when H_0 is correct is fixed for any σ .

It should be noticed that if $N_3 - N_2 = 0$, this is the Pearson-Chandrasekhar's statistic for the testing of outlying observation.

33. Simultaneous Estimation of Parameters in Multiple Regression Analysis with Correlated Residuals.

K. S. RAO, Bombay.

D. G. Champernowne (1948) considered the problem of serial correlation among the residuals in multiple regression analysis and estimated the autoregressive coefficients along with the regression coefficients. He considers a relation of the form

$$Z = \sum_{r=1}^k \lambda_r f_r + \lambda_0 + X \quad (3.5 : 89)$$

where f_1, \dots, f_k are independent of X and X is an unpredictable disturbance. He postulates a relation of the form

$$(X_t - c) - b_1(X_{t-1} - c) - \dots - b_s(X_{t-s} - c) = \epsilon_t \quad (3.5 : 90)$$

Under various assumptions that some of the parameters are known he proceeds to obtain the best estimates for the remaining. In this paper has been developed, for the case when n is large, a technique of simultaneous estimation of parameters at the same time as the regression coefficients strictly under conditions when the least squares method of estimation is valid.

Section III, Physics.

49. Entropy and Specific Heat of Liquid He^3 .

E. C. GEORGE, Bombay.

The entropy and specific heat of liquid He^3 in the region of very low temperatures have been studied experimentally by several investigators.¹ Based on the model of an ideal Fermi-Dirac gas, Singwi² has calculated these thermodynamic functions. It has been pointed out³ that because of the extremely large zero-point energy, the gas model is applicable. The calculated and experimental values show good agreement in the region $\sim 1^\circ\text{K}$ to 2.5°K . Below 1°K , the experimental values do not agree with the theoretical ideal gas values. This is perhaps due to the fact in the above calculation,² the interaction between helium atoms was neglected. Using a perturbation method, we have recalculated the entropy and the specific

with a Lennard-Jones potential between the He atoms. The expressions are as below :

$$S = S_{ideal} = \frac{2\pi N^2}{V} \frac{3\pi^2}{T} \left(\frac{kT}{\eta_0}\right)^2 \left[1 - \frac{\pi^2}{24} \left(\frac{kT}{\eta_0}\right)^2 (2\pi r k_0)^2\right] \\ \times \int \left[\frac{\sin 2\pi r K_0 - 2\pi r K_0 \cos 2\pi r K_0}{(2\pi r K_0)^3} \right]^2 U(r) r^2 dr \\ C_v = C_{v,ideal} = \frac{2\pi N^2}{V} \cdot \frac{1}{T} \cdot \left(\frac{kT}{\eta_0}\right)^2 \left[1 - \frac{\pi^2}{8} \left(\frac{kT}{\eta_0}\right)^2 (2\pi r k_0)^2\right] \\ \times \int \left[\frac{\sin 2\pi r K_0 - 2\pi r K_0 \cos 2\pi r K_0}{(2\pi r K_0)^3} \right]^2 U(r) r^2 dr$$

where η_0 is the Gibbs free energy per particle at $T = 0$ and K_0 corresponds to the top of the Fermi distribution at $T = 0$.

$U(r)$ is the intermolecular potential field. It is seen that the change in the values of S and C_v is in the right direction and quantitative agreement obtained in the low temperature values.

Numerical calculations have been made with a Lennard-Jones intermolecular field of the form

$$U(r) = 4\epsilon \left[\left(\frac{r}{\sigma}\right)^{12} - \left(\frac{r}{\sigma}\right)^6 \right]$$

REFERENCES

1. G. de Vries and J. G. Daunt—Phys. Rev., 92, 1572 (1953); 93, 631 (1953).
T. R. Roberts and S. G. Sydorak—Phys. Rev., 93, 1418 (1953).
Osborne, Abraham and Weinstock—Phys. Rev., 94, 202 (1954).
2. K. S. Singwi—Phys. Rev., 87, 540 (1952).

50. Ultrasonic Velocity and molecular Volume.

M. RAMA RAO, New Delhi.

A plot of Rao's constant $R = v^{1/3}V$ against M , the molecular weight of successive numbers of homologous series reveals that for any one series the points lie on straight lines having the same slope viz. $R = \alpha M + \beta$ where α is independent of the series having a value of 14 according to Rao and 13.535 according to Lageman Wolsey etc. and 13.56 according to Parthasarathy. Parthasarathy however used a modified form of Rao's equation namely

$$\frac{v^{1/3}}{\rho} = \alpha + \frac{\beta}{M}$$

The explanation of the constancy of α for all series is to be traced to the fact that the difference in R value for two successive numbers of homologous series differing in molecular weight by 14 is a constant having an average value of 195 according to Rao and 189 according to others. The result is extended to the case of the Parachor.

51. Comparative study of the roles of Argon and Oxygen in the suppression of I(P) with respect to II(P) system of N_2 as observed in air.

D. D. DESAI, Bombay and N. R. TAWDE, Dharwar.

Influence of argon on the intensity distribution in I(P) and II(P) systems of N_2 has been studied in the three mixtures, viz. (i) a trace of argon in N_2 , (ii) 50:50

Late Abstracts : Section of Physics

mixture of A and N_2 and (iii) a trace of N_2 in Argon, by one of the authors (D. L. ~~order~~). Similar study corresponding to 5%, 20%, 50% and 95% mixtures of O_2 in 'no' has also been done by Koregaonkar for the role of oxygen.

From the results of these two studies, an attempt has been made, in this paper, to analyse the comparative rôle played by a trace of argon and 20% oxygen, in bringing about the relative suppression of I (P) system with respect to II (P) system in air.

52. Transition Probabilities in bands of Blue-green system of TiO by numerical integration methods of Bates and of Pillows.

M. V. SHINGRE, D. D. DESAI, Bombay and N. R. TAWDE, Dharwar.

Of the various methods available for the evaluation of transition probabilities of bands of diatomic molecules, Hutchisson's earlier method has been applied, to the bands of blue-green system of TiO molecule in this laboratory. Since this method does not take into account the asymmetric nature of the molecule so closely, it was thought desirable to calculate the values of transition probabilities of this band system by the method of numerical integration as given by (1) Bates and (2) Pillows' improved method. These methods have shown better agreement with experimental values in some band system of N_2 .

For this purpose, several integrals are evaluated with the knowledge of appropriate constants from Hertzberg's and Phillip's data respectively and final values obtained from the squares of the overlap integrals. Theoretically calculated values are compared with experimental ones. A better agreement appears to exist for lower quantum numbers.

53. Influence of Solar Activity on Weather.

S. RANGARAJAN, Kodaikanal.

Some evidence is now available to indicate that the general circulation of the atmosphere is influenced in a rather complex way by variations in solar activity, but at present very little is known about the underlying mechanism. There is, however, sufficient justification to assume that variations in the solar ultraviolet radiation and corpuscular radiation are mainly responsible for the observed solar-weather relationships. A logical step towards a better understanding of the underlying phenomena seems to be a study of short period changes in solar activity and the associated changes in tropospheric weather.

Recently the author reported a tendency for surface barometric pressures at some stations to undergo a 27-day recurrence tendency during periods of low sunspot activity. Further examination of pressure data has generally confirmed that the 27-day recurrency tendency does occur at many stations under favourable conditions. This phenomenon, associated with solar rotation, seems to indicate a direct influence of solar corpuscular radiation on day to day changes in barometric pressure. To study the exact nature of this influence, 37 occasions were chosen during the period 1952-1954 when there was a sudden increase in geomagnetic activity from relatively quiet conditions. These occasions were taken as coincident with a sudden impact of solar corpuscular radiation on the upper atmosphere. In 25 out of the 37 cases, a widespread fall of barometric pressure was found to occur over the Indian region about three days after the impact of corpuscular radiation. It is proposed to extend this investigation to cover past epochs also of low sunspot activity.

Proc. 42nd Ind. Sc. Cong. : Part IV

Section IV, Chemistry.

293. Salinity in Rain water.

A. K. MUKHERJEE, Jodhpur.

An equation connecting the salinity of rain water with actual precipitation has been derived. This has been verified by previous workers' data on the subject. The important conclusion arrived at in the light of this new equation is that NaCl probably remains as bigger particles suspended in the air.

294. A New Technique in Electrolytic Practice.

H. V. K. UDUPA and B. B. DEY, Karaikudi.

The principles underlying the use of rotating electrodes in electrolytic practice have been discussed by the authors in earlier publications. The application of this technique for electrolytic preparation of a few chemicals are discussed in this paper.

The preparation of p-aminophenol, salicylaldehyde and calcium gluconate using this new technique have been discussed. The apparatus used is also described.

The suitability of the technique for commercial production of these chemicals is briefly discussed also.

295. Utilisation of South Arcot Lignite for the Production of Calcium Carbide.

Ind. Phys. Rev., **94**, 202 (1954).

Singh *Ind. Phys. Rev.*, **87**, 540 (1952). *Production of Calcium Carbide*.

A. JOGARAO and A. SREENIVAS, Karaikudi.

This paper indicates the possibilities of using the extensive deposits of lignite recently found at Neiveli in South Arcot District, Madras State, for the production of calcium carbide in South India, which at present, suffers from particular handicap of having to depend upon the supplies of coal from the distant coalfields of Bengal and Bihar. Typical results of a series of experiments using a submerged arc for the laboratory scale preparation of calcium carbide, to begin with, are presented in which air-dry lignite and lignite-char are substituted for coke. A small percentage of petroleum coke was also added to the limestone lignite-char combinations in the course of certain experiments. The calcium carbide produced in the various experiments was tested for the gas yields in accordance with the procedure laid down in the British Standard Specifications. From the values of the gas yields obtained, it is pointed out in this paper that while lignite-char as well as green lignite (air-dry) have shown definite promise as good substitutes for the usual grades of coke ordinarily used in commercial practice in this country a small addition of about 10 to 15 parts of petroleum coke to 50 parts of lignite-char has given a product which not only passes the B.S.S. tests but which has given more than the maximum yield of gas as stipulated in the B.S.S.

296. Influence of Inorganic Salts on the R_F Values of Amino Acids.

G. C. GOSWAMI, A. SAIKIA and P. C. GOSWAMI, Gauhati.

The R_F values of amino acids have been found to be affected profoundly by the inorganic salts. The higher the concentration of the salts, the greater is the effect. The effect decreases as the salt concentration diminishes and ultimately tends to

disappear altogether. Where concentration of inorganic salts is of the order of $M/100$, or higher, it is necessary to separate them first in order that the amino acids can be identified by their R_F values.

Section V, Geology & Geography.

102. The Geographical Background of the Location of Cottage Industries in Uttar Pradesh.

S. M. TAHIR RIZVI and MASUDUL HASAN, Aligarh.

The paper attempts to evaluate the location of various cottage industries in the state of Uttar Pradesh as determined by the geographic factors. A rapid survey of important cottage industries has been made with a view to prove that their existence, growth and development are, more or less, due to geographic factors and their interaction.

Having a large size, an advantageous location, an agriculturally productive climate, a varied combination of natural resources, and a fair industrial capacity, it is in the fitness of things that the state is well endowed with cottage industries which have much scope of further expansion in the industrial planning of the state. Geographically well situated; agriculturally more productive in respect of raw materials for industries; economically more advanced; and sociologically more populous in India; the state is undoubtedly destined to hold a dominant position in respect of development and expansion of cottage industries planned and organized under geographical conditions.

The present demographic position of the state, the disequilibrium which exists between agriculture and industry, make it imperative that industries, particularly the cottage industries should receive careful consideration by the Government as well as the public.

103. The Tasar Silk Industry of Bihar.

S. A. MAJID, Patna.

The paper is a brief study of the Tasar silk industry of Bihar. It deals with the geographical home of the Tasar Silkworm (*Antheraca Paphia*), the tasar hosts, the rearing and collection of cocoons, the extent and value of cocoons produced, the reeling and weaving industry, the nature, value and market of the manufactured goods, the important manufacturing centres and the prospects of the industry.

104. Argentite from the Zawar Mines, Rajasthan.

S. RAYCHAUDHURI, Calcutta.

Besides occurrence in the native state, silver is found to be present as the mineral Argentite (Ag_2S) in the lead-zinc-silver ores of the Zawar Mines. This is revealed from an examination of some polished sections of the ores under the ore-microscope aided by tests employing other techniques including chromatographic contact print method. The mineral occurs in minute specks and patches, infilling space between galena or sphalerite grains, or sometimes as minute blebs along cleavage in galena. The mineral is greyish-white with a distinct green distinguishing it easily from native silver, possesses a weak reflection pleochroism and a very low hardness and is isotropic. Etch tests show HNO_3 , HCl , KOH negative while

KCN, FeCl_3 , HgCl_2 positive reactions. Light appears to etch the mineral grey hiding sometimes its apparent identity. The silver radical is confirmed by the micro-chemical bichromate test and the electrographic contact prints using *p*-dimethyl-amino-benzylidene-rhodanine which gives a characteristic red-violet colour. Arsenic, antimony etc. are found to be absent in the constitution of the mineral. It also appears probable from contact print tests so far made, that the silver may not occur in the solid solution in galena or sphalerite but exists as argentite or in the native state. The paragenesis of ore minerals found associated with argentite* has been in the order—pyrite, sphalerite, galena and argentite.

105. Syllabus of Local Geography in Secondary Schools.

L. V. KULKARNI, Dharwar.

In order to test the knowledge of Local Geography, 203 students from the First Year Arts and First Year Science were tested. The questionnaire including 14 questions of elementary nature was given and they were asked to answer them within half an hour. Out of 203 candidates examined, only 20% have passed; 14 of them obtained less than 10 marks and 4 students got zero! This test has revealed that Local Geography is neglected in Secondary Schools. Secondly, the causes for this state of affairs are discussed : (1) Geography is not considered as a major subject. (2) No provision of Local Geography in the syllabus. (3) Teachers are not trained. (4) Lack of Funds. (5) Rigid curriculum. Remedies have been suggested to improve the status of geography. Finally a syllabus of Local Geography is proposed for the VIII, IX and X standards which includes the observation and records of temperature etc., Surveying and Field-work, and Interpretation and the making of maps. Surveying of the village is proposed for the VIII standard, surveying the school area is suggested for the IX, and survey of the School District is proposed for the Standard X.

106. Natural Regions of India—a Problem for the Indian Geographers.

PRAMATHANATH HORE, Calcutta.

This paper deals with how the concept of "Natural Region" changed from the first decade of the twentieth century to the present day. But even to-day the geographers differ in their definitions of "Natural Region". Even in countries where much geographical works have been done the natural regions delimited by one rarely coincide with those made by others. The paper also points out how different authors have divided India into natural regions according to their own concepts of Natural Regions. This is why in India the natural regions done by one author differ much from those worked out by others. Inadequate data and lack of geographical research are responsible for divergence.

Finally the paper puts forward some questions before the Indian geographers :

1. What should be the correct definition of a Natural Region and a Geographical Region? What are the distinctions between them?

2. What should be the basis or what indices should be used to delimit a natural region and how this should be worked out?

3. What should be the basis of dividing the natural regions into sub-regions?

In conclusion the paper suggests that the discussions of the symposium should be published and made available to the Indian as well as to the foreign geographers.

107. A study in Coastal Settlements, North Kanara District, Bombay State.

M. S. HONRAO and V. R. PRABHU, Dharwar.

This paper aims to examine the urban landscape of North Kanara Coastlands, with a case study of its leading town, Karwar ($14^{\circ}48' : 74^{\circ}8'$). The present urban structure of the town shows clearly how the natural and human factors have played their role in turning the fishing village into a modern town. Due to its spacious natural harbour and its orientation English enterprise was attracted. Noticeably this has been the main spring of urbanisation of the original fishing village.

Unlike all other towns Karwar has more than one nucleus. Kone which is the main nucleus shows oldest structures reflecting the flourishing conditions of commerce which the port enjoyed. As is common of old parts, this area is closely built and populated. The Administrative Area with the Coastal situation exhibits a landscape pattern with English influence. These have contributed to the development of the present Central Zone. It is the commercial, educational and social centre of the town.

The Port area still reflects the prosperous past. Kodibag - the river port, has added to its activities.

The modernized fishing industry has imparted to the port landscape a characteristic aspect.

Population distribution exhibits a pattern fitting to the general build of the town revealing segregation.

Almost the whole town is unplanned, showing a need for conscious planning.

108. New "frontier" in the Micropalaeontology of the Trichinopoly marine beds.

S. S. GOWDA, Bangalore.

Micropalaeontological studies have shown in recent times that there are some fossils which are not given the attention they deserve and which have been 'orphaned'. Among such orphaned microfossils which constitute new frontiers in the field of micropalaeontology in general, one (holothurians) has been dealt with by the author (*Curr. Sci.*, 23, pp. 152-53).

The present paper deals with the detailed description with measurements of the various genera found in these beds. While some forms resemble those of the modern times, there are a few which resemble those of Eocene and, in some cases, those from the Liassic also. The following genera are described: *Zygothuria*, *Aleothis*, *Myriolochus*, *Lactinophasma* (2 species), *Astichopus?* and *Ancistrum*. It is very interesting to find the last mentioned genus in the Cretaceous bed, for it was considered as purely Palaeozoic in age till Issler found it in the Liassic of Schwaben.

Since they are restricted in vertical range in the Trichinopoly marine beds they are considered as of correlative value "regardless of whether they are made in the same factory and of the same metal." The author would be grateful to those who would, by their criticisms and comments, help him in establishing their biological relationship and also their distribution in time and space.

109. Mathura—a Socio-Geographic Study.

S. D. MISHRA, Nagpur.

This monograph is an objective and factual socio-geographical study of the town of Mathura with due emphasis on its historical back-ground. The settlement

pattern is the outcome of the riverine and the city morphology. The narrowness of lanes and the lattice styled old houses of red sandstone reflect a deep seated geographical basis incorporating the space relationships and the durability of the building material. The paper deals with the following points in detail :—

Ancient History and Archaeology—History of excavation—History of Museum—The Mathura Art—River side and important features—Topographical-profile of the Settlement—House types—Chief industries—Choubas of Mathura—Conclusion.

Section VII, Zoology and Entomology.

124. Respiratory Mechanism in the Chelonia.

J. C. GEORGE and R. V. SHAI, Baroda.

In the three pond turtles *Lissemys punctata granosa*, *Lissemys punctata typica*, and *Lissemys punctata senala* and the tortoise *Geomyda trijuga* it is found that the lung wall possesses an outer striated muscle layer. It is suggested that it helps in the contraction and relaxation of the lungs which cause expiration and inspiration respectively and that it may be universally present in all chelonians.

125. Fauna of the Kashmir Valley : Leeches.

T. D. SOOTA, Calcutta.

The author gives an account of the leeches from Kashmir Valley present in the collections of the Zoological Survey of India, including three species, viz., *Glossiphonia complanata* Linnaeus, *Eipobdella octoculata* Linnaeus and *Haemopsis indicus* Bhatia, collected recently by a party from the Zoological Survey of India that visited the valley during May-June, 1954. Twelve species, belonging to eight genera, known so far from Kashmir, have been listed. The preponderance of palaerctic species among leeches of Kashmir suggests that this group entered Kashmir Valley from Europe and Northern Asia. Presence of polytypic species indicates their great antiquity.

126. On a new species of trematode belonging to the genus *Philophthalmus* Looss, 1899, from the eyes of Bird in Hyderabad-Deccan.

GANESHPERSHAD JAISWAL, Hyderabad (Dn.).

In this paper a new species of *Philophthalmus aquillai* is described from the orbital cavity of a Tawny Eagle, *Aquila rapax*. The species under study differs from all the known forms in the advanced position of its genital pore, which is much above the intestinal fork and also in the disposition of the gonads which are located in the hindmost part of the body.

127. On the correlation between fish-food and fish-gut in food fishes of U.P.

S. M. DAS and S. K. MOITRA, Lucknow.

Although it is common knowledge that the length of the alimentary canal in fishes varies according to their food habits (herbivorous, omnivorous or carnivorous), yet few quantitative data are available of the ratio that exists between

the gut-length and the body length in Indian fishes. A quantitative ratio has been established for each species of fish studied, and we find this ratio to be fairly constant. It is the highest in herbivores, falls in omnivores and is the lowest in carnivores.

The limits of the three categories may be seen in a curve constructed from the species-constants. 515 fishes of different sizes belonging to the following species viz., *Cirrhina mrigala* (Ham.), *Cirrhina reba* (Ham.), *Amblypharyngodon mola* (Ham.), *Gadusia chapra* (Ham.), *Barbus stigma* (C. & V.), *Rohtee cotio* (Ham.), *Mystus vittatus* (Bloch), *Mystus cavasius* (Ham.), *Callichrous pabda* Ham., *Chela bacaila* Ham., *Wallagonia attu* (Bloch), *Ophicephalus striatus* Bloch, *Glossogobius giuris* (Ham.), *Ambassis ranga* (Ham.), *Ambassis nama* (Ham.), were obtained locally for routine examination of their gut contents. On the basis of the dominant food the fishes were broadly divided into three groups viz., herbivores, omnivores and carnivores. On plotting the total gut-lengths against the total body-lengths of the fishes on a graph a definite ratio was found to exist for each species and was expressed as a straight line. Of the fifteen species studied only two have intestinal caeca while the length of the different regions of the gut varies radically in the different species, and is correlated with the food-habits of the species.

128. On fish mortality in tanks and ponds of U.P.

S. M. DAS and S. K. MOTTRA, Lucknow.

An unusual phenomenon of mortality of fresh-water fishes occurred in two tanks in the vicinity of Lucknow on the 3rd of June, 1954, just after the onset of the first rains. A list of the species, age-groups, and quantity of the fishes destroyed is given below :—

Species.	Age-groups.	Quantity.
<i>Calla calla</i> (Ham.)	2 to 3 years	2½ maunds.
<i>Gadusia chapra</i> (Ham.)	2 to 3 years.	3 maunds.
<i>Mystus seenghala</i> (Sykes)	2 years.	5 seers.
<i>Labeo calbasu</i> (Ham.) ...	2 to 3 years.	2 maunds.
<i>Labeo rohila</i> (Ham.) ..	2 to 3 years.	2 maunds.
<i>Cirrhina mrigala</i> (Ham.) ...	2 to 3 years.	2 maunds.
<i>Wallagonia attu</i> (Bloch)	2 to 3 years.	1 maund.

The causes of the mortality as ascertained by preliminary observations are as follows :—

(a) Death due to clogging of gills by means of algae flowering in June, the gills are choked and no respiration is possible.

(b) Death due to liberation of H_2S in the surrounding water, just after the first rains, and the washing into the tank of putrified material from the surroundings.

(c) Death due to increased amount of CO_2 in the environment and depletion of O_2 content on account of increase in zooplankton.

129. On intermediate stages in the evolution of afferent arches from fishes to amphibia.

S. M. DAS and D. B. SAXENA, Lucknow.

There is a common origin of the third and fourth afferent branchial arteries in *Clarias* as also in *Ophicephalus* (Das & Saxena, 1954). We have found that in *Heteropneustes* the second, the third and the fourth afferent arteries all originate from the same aperture. This is clearly an advance over all the fresh-water fishes

worked out so far. It would not be an exaggeration to state that a further advance in this line (of origin of the afferent arteries by a common aperture) would lead us to the Amphibian condition, where all four afferent branchials have a common root (as in a 12 mm. tadpole of frog). This series may be shown as starting from the *Labeo* condition, where all four afferents open separately, passing through *Clarias* and *Ophicephalus* condition and finally through *Heteroneustes* condition to the amphibian stage.

130. The myology of *Funambulus palmarum* Waterhouse (the Indian palm squirrel).

S. M. DAS, Lucknow.

The present paper is the first contribution on the functional anatomy of the squirrel.

Over one hundred and forty muscles have been identified in the squirrel. The chief distinguishing myological characters of *Funambulus palmarum tristriatus*, the Indian palm squirrel, may be summarised as follows: The masseter is very large and does not pass through the infra-orbital foramen; the transverse mandibularis is well marked and the large digastric is divided completely into two bellies, the omohyoid is well marked and the geniohyoids of the two sides coalesce posteriorly; the levator claviculae arises from the atlas, and the subclavius is large, there being no scapulo-clavicularis. The scalenus anticus is absent; of the three heads of M. coracobrachialis only the first is present and well-developed, the flexor hallucis longus is well developed and does not join the flexor digitorum longus; the tendons of the manus are somewhat modified due to only four digits being present.

131. Main trends of fauna investigation in Uzbekistan.

T. Z. ZAKHIDOV, Uzbek SSR.

A general review of the zoological investigations in Uzbekistan and the complex character of an elaborate ecological approach in the determination of the natural resources of a definite territory has been discussed in this paper. The well co-ordinated research work of zoologists, botanists, soil scientists and hydrobiologists made it possible to arrive at practical conclusions to step up production. The complex study also produced a thorough zoogeographical and geobotanical maps of Uzbekistan. All the flora and fauna of the republic and their distribution are now known. The main connections and links of interdependence have been determined between vegetation and definite groups of animals, and this makes it possible to speak of bioscenoses. Ways and means of changing natural aggregates for the purpose of enriching their fauna have ushered. The data obtained have served as a basis for implementing plans for refashioning nature and for reclaiming new lands for further development of the agricultural economy of the country.

Section VIII, Anthropology and Archaeology.

23. Bio-geological Evidence bearing on the Destruction of the Indus Valley Civilisation.

M. R. SAHNI, Calcutta.

Recent disasters as a result of floods in Assam and other parts of the Indian continent and of the world have focussed attention on the widespread destruction

following in their wake, leading to submergence of vast tracts of land and obliteration of entire townships. Some rivers are more prone to floods than others and also possess more unstable courses. There is clear evidence that the Indus belongs to this vagrant category. While engaged in field work connected with water supply problems in Sind during 1940-1941, the author elicited evidence that a flood of unprecedented magnitude must have occurred in the Indus valley in earlier times of which there is now no record, legendary or historical. Attention was first drawn to this in the author's book "*Man in Evolution*" (Orient Longmans 1952).

The author is of the view that this flood was responsible for the destruction of the Indus valley civilisation. The evidence consists of the presence of a considerable thickness of alluvium containing freshwater shells, on the hillocks situated near the Indus banks, of which Budh Takhar in Southern Sind is one. The alluvium here occurs about 130 ft. above present sea-level, that is, 70 feet or so above the present river-bed. As there is no evidence to show that the level of this area and, therefore, of the Indus river-bed was higher than the present, within the last three to four thousand years, the position of this alluvium can only be accounted for by a flood of unprecedented magnitude. Such a flood would submerge everything around the Indus for miles, destroying all trace of civilisation (the Indus Valley Civilisation in the present case). The most significant fact about the alluvium is that it entombs the remains of freshwater and lacustrine shells which suggests prolonged submergence.

The above evidence was confirmed by Mr. Y. Nagappa of the Burma Oil Company, who found about 4 feet of alluvium on a hill-top opposite Jhirak, resting at an altitude of about 75 feet above the present Indus bed.

The paper discusses the changes in the course of the Indus and their possible causes. There is little doubt that apart from normal floods which bring about temporary rise in water-level and alteration in the direction of flow of rivers, earthquakes have played an important role in these phenomena.

24. Rehabilitation of Ex-criminal Groups.

B. H. MEHTA, Bombay

The problem of the ex-criminal tribes is one of the most difficult problems confronting India after Independence.

Need of a scientific approach to guide the proper understanding and treatment of the problem, especially at the community level. Present day tendency of a universal approach to entirely different kinds of social problems is undesirable. The true implication and content of a rehabilitation programme must be understood before objectives and methods of treatment of ex-criminal tribes are determined.

Lack of data and information about historical background to reveal who were the ex-criminal tribes. Several possible theories to explain who they are, and how they came to be considered criminals. They are not tribes ; but only gangs, groups, small communities, or maladjusted sections of major and large tribes, and village communities.

Causes of maladjustment : Individual factors, especially psychological ; lack of adjustment to habitat ; difficulties of economic life ; inability or unwillingness to adjust to law and order concept of modern State, feudal concepts of property, land and forest policies of British Government ; conflict with caste system, etc.

Historical evaluation of British approach to the problem, and consequent protective and preventive measures, social legislation, and programmes of adjustment. Social legislation, methods of registration, identification, restriction, and segregation of so called criminal groups. The failure of British objectives and methods. Causes and consequent of failures. Social maladjustments of the ex-criminal tribes aggravated.

The problem of the ex-criminal tribes as a heritage of British rule to Free India; neglect of these communities after independence in the Constitution; and absence of suitable State agency to deal with the problem.

The 1952 legislative measures do not solve the problem; but are only a beginning of organised social effort. Evident lack of preparation and planning to deal with the subject after legislation.

Suggested methods of rehabilitation, and the need for research, experiments, and evaluation of results of programmes.

Suggested methods :

Method 1. Rehabilitation on land in selected areas acceptable to them.

Method 2. Rehabilitation of small groups, instead of the whole community in areas suitable to them, and the occupations.

Method 3. Intensive programme of vocational training for youth.

Method 4. Partial segregation of children, and organisation of an intensive educational programme from 4 to 18 years.

Method 5. Intensive application of community organisation programme to manageable communities involving

development of physical area, treatment of housing problem, programme of economic development preferably on a co-operative basis, provision of adequate social services for health, education, community recreation, woman and child welfare and community welfare in general, and intensive case work for maladjusted individuals.

25. Rangpur -an Out Post of Harappa Culture.

S. R. RAO, Baroda.

Rangpur is a small village 20 miles S.E. of Limdi in Jhalawar District of Saurashtra. Since 1935 it is regarded as an out-post of Harappa Culture. Recently doubts have been expressed regarding its cultural relationship with Harappa. Rangpur was again excavated in 1954 by the Central Archaeological Department to decide whether or not Rangpur had cultural or generic relationship with Harappa. As a result of the excavation two distinct cultures are noticed.

In the early period of Harappa type of pottery with Amri technique and motif in painting is noticed. This Harappa-Amri culture survived for a longer time in a degraded form in the transition phase. A post-Harappa culture characterised by the use of a lustrous red painted ware associated in top levels with Black and Red ware of Megalithic fabric succeeded Harappa culture at Rangpur. Other antiquities like disc beads, stone weights, chert blades and copper axe found in the early cultural levels are similar to those found at Harappa. The Black and Red Ware of the succeeding cultural period helps dating the two cultures. It is now possible to say that Rangpur had cultural contacts with Harappa and Amri and the post-Harappa pottery forges one more link between the Maruyan culture and the Harappa Culture.

26. "The Antiquity of the Karnatak Rock Engravings".

V. D. KRISHNASWAMI, Hyderabad-Deccan.

Pecked rock engravings in the Karnatak region have been noticed since the eighties of the last century (i) at Kappagallu near Bellary; (ii) in the Raichur doab in Hyderabad; (iii) on the Gombigudda Hill (Jamkhandi State) in Belgaum District; and (iv) at Chitaldrug in Mysore. The author has also discovered a fifth group of graffitti figures at Pattadkal near Badami in the Bijapur District. All of these,

however, present a striking similarity of technique and of figures that would force anyone to study as a whole to assess their archaeological value.

Col. D. H. Gordon, in 1951, reviewed the Kappagallu graffiti and desired a fresh study of them from the point of view of their dating. A survey of the graffiti motifs observable on the boulders of the trap dyke at Kappagallu leads one to classify them as under :--

- (i) Animal motifs pecked in outline.
- (ii) Animal motifs pecked in outline as well as pecked all over the body.
- (iii) Vehicle motifs.
- (iv) Plain human motifs.
- (v) Human sexual motifs.
- (vi) Divine motifs.

In all these six categories the most ubiquitous technique employed appears to have been by pecking with a hammer stone of the same type of rock as the one on which the bruising is made. The figures invariably disclose that the outline has been obtained by repeated punching blows.

The evidence collected by the author, on the Kappagallu group based on pecking technique and patination of rock and subjects pecked, goes to show that the Kappagallu group as a whole is not at all pre-historic but is of a recent historic date that could not go beyond the antiquity of the Sirivaram village facing the engraved trap dyke. This tentative conclusion based on Kappagallu should be verified and amplified by detailed study of the graffiti in the Raichur doab as Captain Munn wished for and the "Gombigudda Hill" of pictures in the Jamkhandi State published by R. S. Panchamukhi. It is also necessary to find out the nature of the graffiti at Chitaldrug and its extent in space in the Chitaldrug region as, climatologically and geologically all the five groups belong to the same Karnatak plateau region.

Section X, Agricultural Sciences.

62. Binomics of *Serinetha augur* Fabr. and its association with *Dysdercus cingulatus*, the red cotton bug.

C. P. MALHOTRA, Ranchi.

Serinetha augur Fabr. is a brightly coloured bug of the family Coreidae. It was discovered that the bug has the curious habit of thriving on ripe stone hard seeds of Kusum (*Schleichera oleosa*) and on cotton seeds also. Kusum is one of the major hosts of the lac insect, and from the point of the quality lac, the most important one. The bug seems to affect the germination power of Kusum seeds. Feeding and breeding technique and life history of the bug described. The bug displays dimorphism and cannibalistic in habits. Its association with the red cotton bug *Dysdercus cingulatus* is also discussed.

63. Loss of Vitamin A potency during the preparation of ghee from milk.

H. S. PATEL and B. M. PATEL, Anand.

The average loss of carotene and vitamin A in 14 trials of ghee making from milk of Kankrej cows was 21.0 and 30.0 per cent respectively.

Ghee making from colostrum milk of Kankraj cows showed higher losses of carotene and vitamin A as compared to that from normal milk as the initial concentration of these in the colostrum milk was comparatively very high.

Methods of making ghee have no influence in varying the losses of carotene and vitamin A. About 20 per cent vitamin A is also lost when ghee is prepared by indigenous method from buffalo milk.

64. Vitamin A potency of colostral milk of Kankraj cows.

H. S. PATEL and B. M. PATEL, Anand.

The average yield of first colostrum was 10.5 lb. with 3.2% fat having 45.7 μ gm. of carotene and 285 I.U. of vitamin A per gram fat. In the next milking the average yield dropped down to 5.7 lb. and the fat percentage increased to 5.3. In the subsequent milkings the milk yield gradually increased to 8.3 lb. in the 8th milking and the fat percentage varied irregularly between 4.5 and 5.5 and the carotene and vitamin A contents decreased respectively to 7.3 μ gm. and 55 I.U. per gram fat.

The secretions of total carotene and vitamin A in the first colostral milk was 3 times that in the 8th milking. However, the first colostral milk was 12 times richer in carotene and 10 times richer in vitamin A in comparison to normal herd milk.

65. Refrigerated storage of purple passion fruits (*Passiflora edulis* Sims).

J. S. PRUTHI and GIRDHARI LAL, Mysore.

Results of the extensive studies conducted during the last 3 years on the cold storage of purple passion fruit (*Passiflora edulis*, Sims) at 8 different storage temperatures viz., ranging between 32-65°F and room temperature (74-91°F) revealed the least physiological losses occur at 42-45°F and 35-38°F, the respective figures for the two temperatures at the end of 5 weeks storage being 32.69 and 34.40% in comparison to 78.38% at ordinary room temperature (74-91°F). Low temperature injury was noticed at 32-35°F, 35-38°F and to some extent at 39-42°F. The optimum storage temperature for passion fruits has, therefore, been reported to be 42-45°F (R.H. 85-90) and a storage life (as confirmed by respiration studies) of about 4-5 weeks.

Losses in the weight of fruit packed in Polyethylene bags was almost negligible, while dipping the fruits in hot paraffin was prior to storage, brought the losses down to 2.5% at the end of 4 weeks' storage at 42-45°F, the comparative figures for control being 23.18%.

The causal organisms were isolated, purified and identified as *Penicillium* sp., *Aspegillus* sp., *Fusarium* sp., and *Rhizopus* sp. The pathogenicity trials revealed that these fungi have considerable deleterious effect on the physiology of the fruit, penicillium having the maximum effect. Out of the large number of available chemicals for use as preventive measures against these fungi, dipping the fruits in dilute solutions of formaldehyde (2%), Iodine (2%), Boric acid (5%) and alcohol (95%) proved to be most effective. Further, washing the crates with 2% Lysol solution prevented the attack of these microorganisms upto a storage period of 5 weeks at 42-45°F.

66. Studies on the nutritive value and utilisation of purple passion fruits (*Passiflora edulis* Sims).

J. S. PRUTHI and GIRDHARI LAL, Mysore.

Results of a series of investigations conducted during the last 3 years on the nutritive value, processing and utilization of purple passion fruits (*Passiflora edulis*, Sims) have been reported. The detailed analysis of the juice (comprising about 35% of the whole fruit) revealed it to be a fairly rich source of carotene (0.5 mg/100 g.) and ascorbic acid (35.0 mg/100 g.). While studying the effect of regional variability, seasonal variation, plant to plant variation, etc., considerable variation was noticed with respect to the physico-chemical composition of the fruit. Employing paper

chromatographic techniques, 2 organic acids (citric and malic) and 3 sugars (glucose, fructose and sucrose) have been identified in the juice. Among the carotenoids phytofluene, and β carotene have been identified. About half a dozen products have been prepared from the juice, the most promising of which are squash, cordial, pop, treacle, etc. Further, the juice makes good blends with other less acid juices like mango, apple, pineapple etc.

The peel, which hitherto constituted a big waste has been found to be a fair source of pectin (10-12% on dry wt. basis). Jam, jelly, candy, preserve and sweets have been prepared. Animal feeding trials conducted reveal that it could replace South Indian rice diet upto 20% level.

Seeds, comprising about 10-20% of the whole fruit, have been found to contain, 20-25% of semi-drying oil (iodine value 142.0). By conducting rat feeding trials, its digestibility coefficient was found to be of the order of 97%. The oil has been refined and hydrogenated.

67. Germination trials on passion fruit seeds (*Passiflora edulis*).

J. S. PRUTHI and GIRDHARI LAL, Mysore.

Data are presented on the rate and percent germination of freshly extracted as well as one year old passion fruit seeds (*Passiflora edulis*, Sims) stored at room temperature (Mysore). Figures for Fruit weight, Fruit composition, seed number, Seed weight etc., are given. Seeds were sown by randomized block system, in seed beds in triplicate, each bed containing 100 seeds in 10 rows. In the case of fresh seeds, the germination commenced within 12-15 days of the date of sowing, and was complete within another fortnight, the percent germination ranging from about 70-95% while the comparative figures for the one year old seeds were only 23-36% and their rate of germination also much slower. Soaking of seeds in hot water overnight did not materially help in the rate and percent germination. The plants came to bearing in about a year. The fruit born were of very good quality. It has been indicated that passion fruit can be successfully grown under Mysore conditions

68. Effect of Pre-emergence treatment with 2,4-D on Weeds in corn and on Various soil properties.

C. H. PATHAK, Bhuj (Cutch).

Three methods of weed control in corn, namely, cultivation with a corn cultivator, close cutting of the weeds without cultivation, and pre-emergence application of 2, 4-D were compared and their effects on corn and certain soil properties were studied.

There was no significant difference in yield or date of maturity between corn on the cultivated plots and on the uncultivated but weed-free plots.

The pre-emergence application of 2, 4-D failed to control the grassy weeds and the corn yielded only 5.9 bushels per acre as compared to 38.3 and 33.8 bushels per acre in the cultivated plots and uncultivated weed-free plots respectively.

Addition of nitrogen to the pre-emergence plots at 20 pounds per acre increased the corn yield to 14.6 bushels per acre, but did not increase the weed yield. An additional 20 pounds of nitrogen per acre resulted in an increase of weed yield only.

Addition of nitrogen reduced the water content of the 2, 4-D treated corn but had no effect on the cultivated or weed-free corn.

On the uncultivated weed-free plots the pre-emergence application of 2, 4-D at 1½ pounds per acre had no injurious effect on corn.

The soil of the cultivated plots and the uncultivated weed-free plots had significantly higher nitrate contents than did the pre-emergence plots.

The soil of the uncultivated weed-feed plots had a higher nitrate content than the cultivated plots, though the difference was not significant.

The corn in the cultivated plots and the uncultivated but weed-free plots showed no deficiency of N, P, K, whereas the corn in the pre-emergence plots was deficient in all the three nutrients.

The rate of infiltration of water into the soil was the most rapid in the cultivated plots and the least rapid in the uncultivated weed-free plots, it being intermediate in the pre-emergence plots.

The average soil moisture of the soil to a depth of 18 inches was highest for the uncultivated weed-free plots and the lowest for the cultivated plots; the pre-emergence plots had an intermediate amount.

Section XI, Physiology

58. Reversed Speech and the Alpha-phoneme Theory.

C. R. SANKARAN, P. C. GANESHSUNDARAM, and
B. CHAITANYA DEVA, Poona.

Observations made by us on reversed speech in the light of the earlier experimental work of Tanakadate (A Study of Japanese Tone Films, Proceedings of the II International Congress of Phonetic Sciences, London, 1935, p. 117) are now re-evaluated in terms of the fresh perspectives of the alpha-phoneme and the alpha-phonoid theories, viz., that CV-VC is a constant, the consonant-vowel configuration and the vowel-consonant configuration being non-commutable (Cf. C. R. Sankaran and P. C. Ganeshsundaram, Time and Speech-structure, BDCRI, vol. 12, pp. 403-404).

59. Subclavian aortic shunt in experimental coarctation in Dogs.

T. C. GUPTA, Dharbanga.

The operation of subclavian aortic shunt in cases of coarctation of the aorta is certainly useful in cases where end to end suture of the aorta after resection of the constricted segment is not possible. Our experimental results support the conclusion of Bing and associates that subclavian aortic anastomosis conveys more blood to the lower part, thereby reducing the pressures above the coarctation.

60. Results of Fractional Gastric Analysis in Normal Indians.

J. D. PATHAK and M. L. PAI, Baroda.

Results of fractional Gastric analysis employing 'alcohol' meal in 31 normal adults, mostly medical students between the ages of 18-24 years are presented. The volume of fasting juice ranged between 2.5 cc. to 88 cc. with an average of 30.1 cc. Their average free and total acidity was 22.00 (± 3.49) cc. and 30.53 (± 3.55) cc. of N/10 acid%.

The limits of free acidity ranged from 0 to 72 cc. while these for the total acidity were between 4 to 80 cc. The incidence of achlorhydrea was 7% and of hyperchlorhydrea (i.e. above the arbitrary level of 60 cc. N/10 acid %) 9%.

The results have been compared with those of other workers in India and elsewhere.

61. Effect of pressure variations in Carotid Sinus on Intestinal movements of the adrenalin, Noradrenaline and acetyl choline.

K. SANJEEVA RAO and D. V. S. REDDY, Madras.

Sympathetecotomia, Vagotomia and variations in the automatic balance appear to influence the intestinal response mediated through the carotid sinus.

The sympathetic nerves and the sympatho-mimetic drugs seem to have a greater relation modify reflexly the tone and movements of the intestine, due to variation in the intrasinsual pressure, or changes in the press receptors. The parasympathetic nerves and parasympathetic drugs do not seem to exert any appreciable or significant effect in modifying the above reflexs under normal conditions.

62. A New Voluntary Muscle Relaxant.

S. K. GOSWAMI

Section III, Engineering and Metallurgy

45. Correlator Study of Nonlinear Systems.

VINCENT C. RIDEOUT, Bangalore.

Linear systems, such as amplifiers and servomechanisms have been studied for many years by measuring their gain and phase response to steady sinusoidal inputs. It is well known that complete knowledge of this response permits one to calculate the response to any other input.

In recent years, the recognition of the fact that information-bearing input signals are essentially statistical in nature has led to the study of the response of linear systems to random "noise", and to noise mixed with signals. Here, again, it is well-known that the time response of a linear system to a unit impulse is equal to the cross-correlation function of the random noise input and output.

The bewildering array of nonlinear systems now of interest to engineers presents quite a different problem from the relatively small and simple class of linear systems. The simple relationships among sinusoidal response, transient response and random noise response no longer hold. It appears, however, that response to band-limited random noise is most valuable criterion.

This paper describes how high-speed electronic differential analyzer techniques have been used to provide rapid means for measuring the cross-correlation of random noise input and output. The resultant easily-obtained curves of peak correlation and of time of peak correlation, both versus input noise power, appear to have some merit as general descriptions of the response of nonlinear systems.

46. The Methods and Uses of Electronic Analogue Computation.

VINCEN C. RIDEOUT, Bangalore.

The past ten years has brought about a great growth in types and uses of analog and digital computers. The chief impetus for this growth, as far as the analog computer is concerned, has been provided by the requirements of the aircraft

industry, and the important new element in computer construction is the vacuum tube. However the uses of the analog computer have spread to many other industries, and the transistor will soon supplement the vacuum tube.

The kinds of analog computers in use to-day include such general-purpose devices as A-C Network Analyzers, Potential analysers, using liquid or paper, algebraic equation solvers, and most important of all, the various kinds of Differential Analyzers. Certain special-purpose analog computers also find considerable use to-day for chemical process controllers and gun-fire controllers.

The Electronic Differential Analyzer using d-c operational amplifiers is a particularly versatile type of computer, capable of giving solutions of practical worth to many engineering problems expressible in linear or nonlinear differential equations. This type of computer, if wide-band amplifiers are used, provides repetitive solutions which can be viewed in complete form on the cathode-ray tube, without flicker. Some sample solutions and studies show the worth of this type of computer, and indicate its proper place among other types of computing devices, such as electronic digital computers.

DISCUSSION

SECTION OF MATHEMATICS

Chairman : DR. B. R. SETH, KHARAGPUR

I. Transforms and their Applications

1. DR. B. B. SEN (Pilani) : *Stieltjes Transforms*

Iteration of the Laplace transform usually gives rise to a result which is known as Stieltjes transform. It can be identified with the integral equation which was originally considered by Stieltjes (Stieltjes, T. J. (1894), *Annales de la faculté des Sciences de Toulouse*, Vol. 8, pp. 1-122) in connection with his work on continued fractions. Conversely, if the above mentioned Stieltjes integral converges, its relations with Laplace transform can also be demonstrated.

The iterated Stieltjes transform again leads to an integral equation of a very interesting type. It is also possible to obtain a new inversion of the Laplace transform by using inversion formula for the Stieltjes transform.

2. SRI GUNADHAR PARIA (Kharagpur) : *Transforms and their applications (Fourier).*

The main idea of the method of Transforms in boundary- and initial-value problems of Mathematical physics is that, instead of finding directly the known quantity involved in a given problem, another quantity which is the integral transform of the unknown quantity, is defined. The initial and boundary conditions are all expressed in terms of the newly defined quantity and the problem is solved for it. Then, the inverse transform gives the required quantity. In elastic problems, both isotropic and anisotropic, the Fourier transform has been widely used, particularly, in topics of the two-dimensional stress distribution in plates, bending of thin plates having various edge-conditions and resting on elastic foundations and transverse vibrations of thin plates. The Fourier integral having the infinite intervals are used when one or more of the dimensions of the medium is infinite. When the dimensions of the medium are limited, the Finite Sine transform may be used. Thus the complicated problems such as the bending of the thin ring sector plate under transverse loads may be easily solved with the help of the Sine transform.

3. DR. BRIJ MOHAN (Banaras) : *Mellin Transforms*

Mellin's Inversion Formula states that, under certain conditions,

$$\text{if } F(s) = \int_0^{\infty} x^{s-1} f(x) dx, \quad \text{then } f(x) = \frac{1}{2\pi i} \int_{c-i\infty}^{c+i\infty} x^{-s} F(s) ds.$$

The idea was first given by Riemann in 1876. But Mellin was the first writer to give an accurate discussion of the formula in 1896.

A familiar example of a pair of Mellin Transforms is

$$f(x) = e^{-x}, \quad F(s) = \Gamma(s)$$

In 1918 Hardy gave a rigorous proof of the reciprocity theorem contained in the formula.

The formula is capable of several transformations. Several forms of the formula have been studied by Plancherel, Zygmund, Pincherle, Cauchy etc.

Every form of the formula may be used for evaluating certain definite integrals. Hundreds of definite integrals have so far been evaluated with the help of various forms of the formula.

4. SRI B. D. AGGARWALA (Kharagpur):

The theory of integral transforms has got vast potentialities as regards its application in both pure and applied fields. When applied to solution of boundary value problems, in particular, it reduces the problem in n dimensions to one in $n-1$ dimensions generally and a successive application of it may at times, reduce the problem to the solution of an ordinary equation. Thus the main difficulty of satisfying boundary conditions is at times solved quite easily.

And in cases of bodies extending to infinity, the results may be obtained in form of infinite integral which may turn out to be integrable. A number of stress problems has been solved in this manner.

But there are cases where it does not seem to be very clear as to how to apply the transform method or what transform to apply. The cases of a clamped rectangular plate and a simply supported uniformly loaded plate with edges in the form of a parallelogram are illustrations.

At times, however, really beautiful results are obtained by transform method which would have been quite difficult otherwise. W. T. Koiter, for example, has solved the problem of a laterally loaded strip with discontinuous boundary conditions by an appeal to the theory of Wiener-Hopf type integral equations in quite an ingenious way.

5. DR. JAMIL AHMED SIDDIQUI:

The theory of transforms can be applied to solve several problems of analysis as has been shown by the works of Paley, Wiener, Carleman and S. Mandelbrogt. The speaker has shown that the following two problems can be solved with the help of the theory of Mellin & Laplace transforms:

Problem 1: Let $f(x)$ be a function infinitely differentiable in $[0, \infty)$ and such that

$$f(x) = O(e^{-B(x)})(x \rightarrow \infty), \quad |f^{(n)}(x)| \leq \lambda^n M_n (n \geq 1) \text{ for } x \in [0, \infty).$$

where $B(x) > 0$ and $\{M_n\}^\infty$ a sequence of positive numbers. What relationship exists between $B(x)$ and $\{M_n\}^\infty$?

Problem 2: Let $b\{M_n\}$ denote the class of infinitely differentiable functions on $[0, \infty)$ such that

$$|f^{(n)}(x)| \leq \lambda^n M_n \quad (n \geq 1) \text{ for } x \in [0, \infty)$$

and let $\{\lambda_n\}^\infty$ be an increasing sequence of positive integers. To find a relationship between $\{M_n\}$ and $\{\lambda_n\}$ in order that $f \in b\{M_n\}$, $f^{(\lambda_n)}(0) = f(0) = 0$ should imply that $f(x) = 0$ i.e. the class be quasi-analytic in the generalized sense.

6. DR. U. N. SINGH : *Generalized Fourier Transforms (in the complex domain).*

Definition of the generalized Fourier transforms in terms of a couple of analytic functions regular respectively in the upper half and the lower half planes, as given by Carleman and proof of the generalized Fourier-theorem:

$$TSTS(f) \equiv f.$$

The proof of Carleman does not hold in the general case. Modification of this and application of this result to various problems in the theory of functions and harmonic analysis.

II. Non-Linear Vibrations

SECTION OF MATHEMATICS

Chairman : DR. B. R. SETH (Kharagpur)

1. DR. B. R. SETH (Kharagpur) :

Non-linear oscillatory systems play an important part in all branches of science and technology. Electronic methods have given us valuable information about the behaviour of such systems. Their mathematical analysis employs all the modern tools like operational methods, matrix algebra and topology. The differential equations for some of these have been studied by prominent mathematicians like Poincare, Liapounoff and Linstedt. In recent years Kryloff, Bogoliuboff, van der Pol and others have devoted quite a lot of attention to them. Van der Pol equation has been widely studied.

In most of the above cases non-linearity arises from the differential equation of the field. Non-linearity arising from the boundary conditions exists in gravity waves which have been extensively treated by Stoker. The case when the stress-strain (or strain-velocity) relation is non-linear has not received much attention. Seth has shown that a non-linear tension-stretch law of the type

$$t = E \left[1 - \frac{1}{1 + \beta s^2} \right]$$

s being the ordinary stretch and E Young's modulus, shows that the vertical oscillations of a particle attached to a light elastic thread are non-harmonic, if the amplitude is not small. In fact it is found that the displacement can be expressed in terms of elliptic functions of the second kind. The same relation shows that the differential equation for non-linear longitudinal vibrations is the same as that for long waves in a canal. Similar results hold good for vibration of a rod struck at one end or suddenly loaded. In all such cases it is found that waves cannot be propagated without change of form.

2. DR. D. N. MITRA (Kharagpur) :

Problems in mechanics are practically non-linear at the outset though linearisation is adopted as an approximating device in many cases to useful purposes. Non-linear problems with one degree of freedom in which external forces are absent and which are not easily integrable are studied to an advantage by graphical method of Lienard. Geometric interpretation as an equation defining a field of directions in the x, v -plane (v denoting velocity) can lead to useful information of a qualitative character even though

the solution-curves themselves cannot be obtained explicitly. Poincare's theory of singularities whether the point $v=0$ is a node, saddle, spiral or centre point developed in case of first order differential equations gives also the qualitative nature of the solution-curves and can at length be usefully employed to discuss stability. Usefulness of the above ideas is illustrated in dynamical treatment of elastic stability of a straight rod subjected to compressive forces along the axis of the rod.

3. DR. V. P. VENKATACHARI (Hyderabad—Dn.) :

Practically all differential equations of Mechanics and Physics are non-linear. Linear approximations are generally used in practical applications. The scope of a non-linear problem is restricted by linearization. A few non-linear examples of practical interest governed by the differential equation

$$m\ddot{x} + p(x) + f(x) = F \cos \omega t \quad \text{are given}$$

Some analytical methods of solution of non-linear problems are discussed with special reference to the contributions made by Russian Mathematicians.

4. DR. G. BANDYOPADHYAY (Kharagpur) : *Orbital Stability of Non-linear vibrations*

The investigations of the variational equation of a non-linear system always leads to the Hill's equation and the solution of this equation is defined (in a narrow sense) to be stable when they are bounded. The investigations regarding the nature of the solutions of Hill's equation depends on the Floquet theory of linear equation with periodic coefficients. It appears at the first sight that the investigation of stability of the variational equation decides completely the question of stability of the system. This, however, is not the case; because the boundedness of difference of the displacements of the disturbed and undisturbed motions *compared at the same time* is not the criterion of stability. Stability may be defined in terms of establishing correspondence between the disturbed and undisturbed motions in such a fashion that time plays no essential role in it. Such a stability is called Orbital Stability (the term being borrowed from Astronomy) and has a more elaborate method of investigation.

III. Absolute Summability of Series

SECTION OF MATHEMATICS

Chairman : DR. B. R. SETH (Kharagpur)

1. DR. B. N. PRASAD (Allahabad) :

2. DR. T. PATI : *Absolute Riesz Summability*

The theory of Riesz summability by 'typical means' and its special applicability to problems concerning the behaviour of Dirichlet series, whose convergence or divergence, is, in general, of a much more delicate character than that of power series, had already become quite familiar when the notion of absolute Riesz summability was introduced by Obrechkoff (Math. Zeitschrift, 30, 1929). If λ_n be a positive, monotonic increasing function of n , steadily tending to infinity with n , and

$$A_\lambda(\omega) = A_{\lambda^0}(\omega) = \sum_{\lambda_n \leq \omega} a_n ; A_\lambda^r(\omega) = \sum_{\lambda_n \leq \omega} (\omega - \lambda_n)^r a_n, r > 0,$$

then $R_\lambda^r(\omega) = A_\lambda^r(\omega)/\omega^r$ is called the Riesz mean of 'type' λ and 'order' r of the infinite series $\sum a_n$. If $R_\lambda^r(\omega) \in BV(A, \infty)$, that is, if $R_\lambda^r(\omega)$ is a function of bounded

variation in (A, ∞) , where A is a finite positive number, the series $\sum a_n$ is said to be absolutely summable (R, λ, r) or summable $|R, \lambda, r|$. By definition summability $|R, \lambda, 0|$ is equivalent to absolute convergence. As in the case of ordinary Riesz summability so also for absolute Riesz summability we expect a reasonable upper limit to the rate of increase of the type to ensure the effectiveness of the method. In this direction Mohanty (Proc. London Math. Soc. (2), 52, 1951) has proved that summability $|R, e^n, 1|$ is equivalent to absolute convergence by making use of discrete Riesz means after Hardy. The equivalence of summability $|C, k|$ and $|R, n, k|$ was demonstrated by Hyslop (Proc. Edin. Math. Soc. (2), 1936). The problem of determining the conditions for the absolute equivalence of two processes of Riesz summability defined by different types and orders seems to have remained unsolved so far, and affords a fruitful line of investigation.

While absolute convergence implies summability $|R, \lambda, k|$, $k > 0$, the converse is not necessarily true. It is of interest to see what Tauberian conditions may be imposed upon the nature of a given infinite series such that its summability $|R, \lambda, k|$, may imply its absolute convergence. The following Tauberian theorem has recently been established by Pati (Math. Zeitschrift, 1954).

If $\sum a_n$ is summable $|R, \lambda, k|$, $k > 0$, $\{a_n \lambda_n / (\lambda_n - \lambda_{n-1})\}$ is a sequence of bounded variation and $\{\lambda_n / \lambda_{n-1}\}$ is a sequence of bounded variation, then $\sum a_n$ is absolutely convergent.

There however, still remains considerable scope of investigation in the domain of Tauberian theorems.

The 'first theorem of consistency' for absolute Riesz summability due to Obrechkoif (loc. cit.) amounts to the assertion that the effectiveness of an absolute Riesz summability process increases with the order if the type remains unaltered. There arises the natural question as to whether anything can be said about the relative effectiveness of any two processes of absolute Riesz summability of which the types are different while the orders are identical. By way of answering this question Chandra-sekharan (Jour. Indian Math. Soc. N. S., 6, 1942) proved the direct analogue of Hardy's well known extension of the classical 'second theorem of consistency' assuming one of the types to be a very special kind of logarithmico-exponential function of the other. Recently Pati (Quarterly Jour. Math. Oxford, 1954) has established the following very general theorem which extends the scope of applicability of the second theorem of consistency and includes Chandrasekharan's results as a particular case.

If $\varphi(+)$ is a non-negative monotonic increasing function of t for $t \geq 0$, steadily tending to infinity as t tends to infinity such that, for positive integral k , $\varphi(t)$ is a $(k-1)$ th indefinite integral for $t \geq 0$, and $\varphi^{(r)}(t)/\varphi(t) \in BV(h, \infty)$ ($r = 1, 2, \dots, k$), where h is a finite positive number then any infinite series which is summable $|R, \lambda_n, k|$ is also summable $|R, \varphi(\lambda_n), k|$.

More recently still Prasad and Pati have obtained a supplementary theorem for the case in which the order is positive and non-integral, assuming that $\varphi^{(1)}(t)$ is monotonic increasing.

Obrechkoif (loc. cit.) was the first to investigate into the absolute Riesz summability of Dirichlet series. He obtained results regarding the asymptotic behaviour of the sum function of Dirichlet series to the right of the line of absolute summability. Results connecting the abscissae of ordinary and absolute Riesz summability of Dirichlet series have been obtained by Bosanquet (Jour. London Math. Soc., 22, 1947 & 23, 1948) and Austin (Jour. London Math. Soc., 27, 1952). A recent result of Tatchell (Jour. London

Math. Soc., 29, 1954) analogous to a well known theorem of Hardy and Riesz has led him to the conclusion that the abscissa of absolute summability, whether finite or infinite, corresponding to the methods $[R, \lambda_n, k]$ and $[R, e\lambda_n, k]$ are identical for every Dirichlet series $\sum a_n e^{-\lambda_n s}$. There seems to be much room for research on the problem of absolute Riesz summability of the Dirichlet product of any two summable series.

Concerning the absolute Riesz summability of Fourier series, its conjugate series and their derived series Mohanty (loc. cit.) has obtained a series of theorems. One of his theorems (Proc. London Math. Soc., (2), 51, 1949, Theorem B) in conjunction with the special case of the Tauberian theorem of Pati, for $k=1$, has led to the formulation of a criterion for the absolute convergence of Fourier series analogous to the well known Hardy-Littlewood criterion for the convergence of Fourier series. The most general results on the absolute Riesz summability of the rapidly increasing type $\exp\{(\log n)^{1+1/\alpha}\}$, $\alpha \geq 1$, including as particular cases previous results of Mohanty (Theorems 4, 6, 7 & 8, Proc. London Math. Soc., (2), 52, 1951) and Pati (Bull. Calcutta Math. Soc., 44, 1952; Trans. Amer. Math. Soc., 1954) have been announced in the abstract of a paper "On the absolute Riesz summability of Fourier series etc.", recorded in the proceedings of the current session of the Indian Science Congress. Pati has obtained a result regarding the absolute Riesz summability of the series $\sum (-1)^n n^p$ which goes deeper than the hitherto known result on its absolute Cesaro summability (Hyslop : Proc. London Math. Soc., 46, 1940). Mohanty (Jour. London Math. Soc., 25, 1950) has shown that summability $[R, \log n, 1]$ is a non-local property for Fourier series. Results concerning the absolute Riesz logarithmic summability of Fourier series are due to Izumi and Kawata (Tôhoku Math. Jour. 45, 1938), Izumi and Matsuyama (Math. Jap., 1, 1949) and Prasad and Misra (40th Indian Science Congress, IV).

3. MR. S. N. BHATT (Allahabad) : *Absolute summability factors*

Given a sequence $\{\lambda_n\}$, if a series $\sum \lambda_n a_n$ is absolutely summable in some sense, while in general $\sum a_n$ is itself not so summable, then λ_n is said to be an absolute summability factor of the series $\sum a_n$.

In 1925 Kogbetliantz (Bull. des Sc. Math. (2), 49, 1925) proved that if $\sum a_n$ is summable $[C, \delta]$, $\delta > 0$, then the series $\sum a_n/n^\gamma$, $0 \leq \gamma \leq \delta$, is summable $[C, \delta - \gamma]$. The restriction $\gamma \leq \delta$ was relaxed by Sunochi (Jour. Math. Soc. Japan. 1, 1949).

The first application of absolute summability factors to special infinite series is due to Prasad (Proc. London Math. Soc. (2), 35, 1933) who established that for a Fourier series

$$(1) \quad \frac{1}{2}a_0 + \sum_1^{\infty} (a_n \cos nt + b_n \sin nt) = C_0 + \sum_1^{\infty} C_n(t)$$

if $\{\lambda_n\}$ be any one of the sequence:

$$(2) \quad \frac{1}{(\log n)^{1+\epsilon}}, \frac{1}{\log n (\log \log n)^{1+\epsilon}}, \dots, \frac{1}{\log n \dots (\log \log \dots \log_p n)^{1+\epsilon}}, \epsilon > 0,$$

then the series $\sum \lambda_n c_n(t)$ is summable $[A]$ for almost all values of t . Prasad also proved a parallel theorem for conjugate series. Izumi Kawata (Proc. Imperial Acad. Tokyo, 40, 1938) proved that Prasad's result holds even when we replace the sequence of summability factors by the more general sequence $\{\lambda_n\}$ where $\{\lambda_n\}$ is convex and such that $\sum n^{-1} \lambda_n$ is convergent. Chow (Jour. London Math. Soc., 16, 1941) established that for such a sequence $\{\lambda_n\}$ the series $\sum \lambda_n c_n(t)$ is summable $[O, 1]$ for almost all values

of t . He based the proof of his theorem on a result of J. Marcinkiewicz (Jour. London Math. Soc., 40, 1939) concerning the strong summability of Fourier series. The set of points at which his result holds, is, therefore, not necessarily the Lebesgue set in which Prasad's result holds. Later Cheng (Duke Math. Jour. 15, 1948) proved that if $\{\lambda_n\}$ be any one of sequences (2) the series $\sum \lambda_n c_n(t)$ is summable $[C, \alpha]$, $\alpha > 1$, in the Lebesgue set. Pati (Duke Math. Jour., 21, 1954) has very recently generalised all these previous results by replacing the sequences (2) in Cheng's theorem by the more general class of summability factors $\{\lambda_n\}$ where $\{\lambda_n\}$ is a convex sequence such that $\sum_{n=1}^{\infty} \lambda_n$ is convergent. He has also obtained the result that if an infinite series $\sum a_n$ is strongly summable $[C, 1]$ and $\{\lambda_n\}$ is a convex sequence such that $\sum_{n=1}^{\infty} \lambda_n$ is convergent then $\sum \lambda_n a_n$ is summable $[C, 1]$. Prasad and Bhatt (volume of Abstracts, Proceedings of the current session of the Indian Science Congress) have carried this line of investigation still further and have also deduced Cheng's theorem on the absolute summability of $\sum c_n(t)/(\log n)^{1+\epsilon}$ (Duke Math. Jour., 15, 1948) by an application of a theorem of Pati (loc. cit.) Theorem 2).

By way of answering the question as to what necessary and sufficient conditions should be satisfied by a sequence $\{\lambda_n\}$ in order that the series $\sum \lambda_n a_n$ may be absolutely summable in the Cesaro sense of a given order whenever $\sum a_n$ is absolutely summable in the Cesaro sense of a certain order Bosanquet (Jour. London Math. Soc. 1945, vol. 20) has established a class of theorems.

Tatchell (Jour. London Math. Soc., 29, 1954) has recently obtained the analogue for absolute summability of a well known theorem of Hardy and Riesz (Theorem 20, The General Theory of Dirichlet's Series, Cambridge, 1952) which includes as a particular case a previous theorem of Mohanty (Jour. London Math. Soc., 25, 1950).

Chow has recently obtained a number of interesting results concerning absolute summability factors of power series on the circle of convergence (Proc. London Math. Soc., (3), 1, 1951; Jour. London Math. Soc., 26, 1951; Quarterly Jour. Math. Oxford, 1953.)

4. DR. M. L. MISRA (Saugar): *On Absolute Summability (A) of Fourier Series and its Conjugate Series.*

A series $\sum a_n$ is said to be *absolutely summable (A)*, or summable $|A|$, if $f(x) = \sum a_n x^n$ is convergent in $(0 \leq x < 1)$ and if $f(x)$ is of bounded variation in $(0, 1)$, and then the sum is $\lim_{x \rightarrow 1-0} f(x)$. Thus a series which is absolutely summable (A) is necessarily summable

(A), but the converse is not true. The notion of absolute summability (A) was introduced in 1929 by J. M. Whittaker who also proved the consistency condition that every absolutely convergent series is absolutely summable (A). Fekete, in 1932, proved that summability $[C, r]$, r being a positive integer, implies summability $|A|$. Littlewood gave an example to show that a series may be convergent at a point without being summable $|A|$ at that point, while B. N. Prasad showed that a series may be summable $|A|$ without being necessarily convergent.

Whittaker proved in 1929 that every Fourier series which converges under Dini's condition is summable $|A|$. Shortly after, Prasad made a thorough and detailed investigation of the summability $|A|$ of Fourier series and obtained a series of important results. He also examined for the first time the summability $|A|$ of the conjugate series. He generalised the result of Whittaker and also proved that a series which converges under Jordan's condition is summable $|A|$. This result was extended by M. L. Misra who

proved that a series which converges in virtue of de la Vallee-Poussin's condition is summable $[A]$. Latter on, Bosanquet extended these results by proving that if $\phi_\alpha(t)$, $\alpha > 0$, the Riemann-Liouville fractional integral mean of $\phi(t)$, is of bounded variation in $(0, \delta)$ and tends to zero as $t \rightarrow 0$, then the Fourier series is summable $[A]$. Bosanquet

and Hyslop proved that the conjugate series is summable $[A]$ if $\int_0^\delta |\psi_\alpha(t)| t^{-1} dt < \infty$,

$\psi_\alpha(t)$ being the mean of order α of $\psi(t) = f(x+t) - f(x-t)$. The summability (A) of the conjugate series was also examined by Takahasi and Kuniyeda.

In order to investigate the bounded variation and behaviours of a complex power series on its radius and circle of convergence, Prasad discussed the summability $[A]$ of Young's Restricted Fourier series and proved that in the interval of restriction the Restricted Fourier series of the second class behaves as the ordinary Fourier series for purposes of summability $[A]$. Misra proved that the same is true for R. F. series whatever be their class.

Absolute summability (A) factors have been obtained by Prasad, Izumi, Kewata and Chow. Kuniyeda & P. L. Bhatnagar have considered summability $[A]$ of the derived Fourier series and conjugate series. Hyslop has proved a Tauberian theorem for summability $[A]$.

Since summability $[C]$ implies summability $[A]$, the results obtained for summability $[C]$ of the Fourier series and conjugate series are also true for summability $[A]$.

5. DR. R. MOHANTY : *Absolute Summability(C)*

6. DR. U. N. SINGH : *Absolute Summability Functions*

IV. Teaching of Mathematics in Engineering Institutions

SECTION OF MATHEMATICS

(Chairman : DR. B. R. SETH (Kharagpur) :

1. DR. B. R. SETH (Kharagpur) :

In the last seven years a number of engineering colleges and technological institutions have been started in the country to cater to the pressing needs of various development projects. The young men have responded and now some of the best of them, instead of seeking clerical and administrative jobs are very anxious to get trained in various branches of engineering. Most of the engineering colleges get applications of which only about ten per cent can be taken. Last year the Indian Institute of Technology received about three thousand applications, of which only about 300 could be taken. It is high time more such institutions are founded so that youthful energy now available can be harnessed in the best interests of the nation.

In the past the engineering institutions taught mathematics in an indifferent fashion. It was considered a bad formal necessity, with the result that the engineer on taking his degree hardly even knew how to use the very elementary tools of the subject. But the big technological advances made in America with the help of mathematics have convinced all concerned that it should be taken more seriously. In fact it

has come to play a vital role in all basic research leading to technological advance. An extra responsibility, however unwanted, has fallen on the shoulders of the mathematician, and it is now for him to prove himself equal to the task.

Many reports have been published in America and England on the teaching of mathematics to engineers at all levels. It is suggested that the Section of Mathematics of the Indian Science Congress in collaboration with the Sections of Statistics and Engineering should set up a sub-committee to study this problem and submit its report at the next session. It can consider both the topics and the standard to which mathematics be taught at all levels in Engineering institutions. Particular attention may be paid to the part it should play in high grade technological institutions where research will play a dominant role.

2. DR. A. K. GAYEN (Kharagpur) : *Teaching of Statistics in Technological and Engineering Institutes.*

Statistics of a special kind is important for many professions and should find adequate place in teaching programmes of Universities and Technological or Engineering Institutes. Mathematics and Mechanics remain as ever to be essential prerequisites for students of Engineering Sciences. But time has come now when want of teachers in Statistical theory in any technological institute will be considered as much an anomaly as the absence of teaching arrangements for mathematics and mechanics. Rapid developments are taking place in statistics and its application in quantitative experiments of general sciences and engineering. Many physical and chemical theories are basically statistical. Theory of probability and statistics is being applied in routine control and factory operations. Sooner or later in his career a scientist or Research Engineer is almost certain to feel for the need of use of statistical methods and it is good that he should adopt the right approach from the start than to wait until later years. Earlier introduction to statistics in the curriculum of studies in Colleges of Sciences and Engineering would as such prove to be highly beneficial. Suitable courses for various fields of applications may be offered in places such as technological institutes. It should however be noted that not many of the students will become practising statisticians and the aim should therefore be to teach students to recognise a statistical problem in the given field of application, to know what kind of solution is possible and to understand the solutions. There will be room for lessons in statistics as an 'option' and this is in line with the developments that are taking place. Some fundamentals of Probability and Statistics should however be taught along with the compulsory courses of mathematics. In other countries attempts are being made for the introduction of suitable syllabi for statistics in vocational training centers and even in the top classes of Grammar schools.

3. SRI A. K. CHAUDHURI (Kharagpur) : *Course in Statistical Quality Control in Technological Education.*

In this age of Industrialisation and development the methods of statistical quality control are found to be indispensable tools in the hands of engineers and industrial workers. The statistical quality-control methods are comprised of the different techniques of applied statistics and the theory of probability—especially as applied to industry in all its three phases of Research, production and Inspection. It has been decisively established in U.S.A., UK. and other countries that the techniques of Statistical Quality-Control provide almost sure guide in matters of policies of production and management towards the most efficient and economic production with improvement in quality at

lower cost. Due to these reasons, it is being strongly felt that engineers may be connected with research or production or management should be thoroughly acquainted with the most important principles of applied Statistics and probability with special reference to their practical applications. This can be achieved by introducing courses in "Statistical Quality-Control" methods in the curriculum of study for a Bachelor's degree of Engineering, the syllabus being suitably oriented to meet the special need of the country. Proper personnel for this purpose should also be raised by selecting a band of people with proper outlook and giving them intensive training in suitable Industries and organisations at home and abroad so that they can be entrusted with teaching in this branch in technological Institutes.

4. DR. V. P. VENKATACHARI (Hyderabad-Dn) :

It is proposed to deal with the following aspects.

1. Relationship between Mathematical concepts and Engineering problems.
2. The importance of approximations in the practical solutions of Engineering Problems.
3. Non-linear problems in the Engineering Science.

5. DR. C. PRASAD (Roorki) : *Mathematics for a Post-graduate course in Engineering.*

A post-graduate course in engineering should equip the student for understanding advanced work being done in any special branch and for further research. As such a knowledge of higher Mathematics becomes essential. For example, a knowledge of functions like Bessel or Legendre, solution of more common partial differential equations, theory of complex numbers, etc. should form a part of the Mathematics syllabus in a post-graduate course. In how much detail they are done will have to depend upon the time available.

Besides this general course, a special duty of the mathematical theory involved in the particular course should be made. Thus for a course in structures relevant portions from the theory of elasticity may be done.

6. PROF. B. D. PURI (New Delhi) : *Teaching of Mathematics and Statistics in Engineering Institutes.*

It is necessary that Higher Mathematics should be taught to all Engineering Students who intend to specialise in any particular branch of Engineering. It is not necessary that students of ordinary courses should learn Higher Mathematics which should be taught by teachers of subjects in which it is needed for specialised courses and research problems. The personnel available in our country for research in Engineering subjects is very meagre and something should be done to produce research students even if it is by introducing subjects of Statistics and Higher Mathematics.

7. DR. K. C. CHAKKO (Aligarh) :

The existing syllabuses in Engineering and other subjects in Engineering Institutions cover too wide a ground and are not specially helpful for research or postgraduate work. These have to be considerably curtailed in order to introduce the new principles of mathematics and other basic knowledge required for future Engineers. It is not at present possible to provide entirely new batch of research Engineers starting from the Intermediate Arts or Science standard because of the cost. It is more practicable to

train the best of the engineering graduates from existing Engineering Colleges by putting them in a few post graduate institutions under well qualified teachers.

8. DR. S. V. CHANDRASHEKHAR AIYA (Poona).

1. Make students mathematically minded
 2. Develop art of thinking
 3. Examples from actual engineering problem.
 4. Need to teach limitation of mathematics and use of approximations
 5. Postgraduate teaching to be done by tutorials & discussion
 6. Mathematics taught must be actually used in the teaching of engineering.
- Engineers & Mathematicians must meet and discuss each other's problems.

9. PROF. A. M. SENGUPTA (Howrah): *Teaching of Mathematics in Engineering Institutions.*

I want to say a few words about the defects in the Mathematical training of the students of Engineering in our country. This is mainly due to the defects prevalent in the syllabus of Mathematics for Engineers. The syllabus of Mathematics, even now, is more or less the same as that followed during the British rule. That syllabus is usually framed without any reference to actual needs and interest in the subject of the Engineering students, the result is that the students lack the knowledge and grasp of fundamental principles, which knowledge is essential for the cultivation of constructive and independent thinking as also of the ability to tackle practical engineering problems.

As regards the needs and interest—an Engineer is interested primarily in the application of Mathematics to the solution of problems. He wants to know how each piece of mathematical theory can be utilized in his work. And so the Engineers' approach to a mathematical concept or theory is different from that of the mathematicians. Further an Engineer is often interested in an approximate solution of his problem, specially when exact solution is complicated.

As regards needs—with the rapid advancement of engineering sciences, the complexity in engineering problems is growing faster—complexity arises from the necessity of including more and more factors in the solutions. Consequently use of mathematics in Engineering has increased to a tremendously great extent. There is few fundamental concept or theory of mathematics which has not the demand or which is not needed by Engineers to be used in the development of one or other of the various engineering sciences. But then, we cannot include everything in our curriculum.

We must bear in mind the limitation of available time.

The development of reasoning power requires time. Further, in our country, even now, in Engineering Institutions mathematics is generally considered a side subject and use of mathematics is looked upon as a tool. Even distinction is made in the cadre of a teacher of mathematics and physics (non-technical subjects) and a teacher of engineering (technical subjects). While in scientifically advanced and industrially developed countries—to quote from the official register of Harvard University “the border line between the engineer and applied scientist is becoming dimmed”.

With the interest and needs of engineering students as also the limitations of the available time constantly in mind, it is high time, though late, to chalk out a course of mathematics on the basis of a reasonable number of fundamental principles having broad

and wide applications in engineering sciences and with emphasis on the technique of application rather than on the mathematical theory.

Before I conclude, I like to note that no emphasis is laid in our country on the various numerical methods of solving engineering problems. That is, the strong-arm method, as it is termed by Dril Pickett, one of the Guest Professors from Wisconsin University, as it provides broad and wide application and offer great facilities for dealing with the now complexities in practical engineering problems which are in practice set by situations, machines and nature.

Finally, we must not forget that we are in a different era. And to quote from Harvard University official register "An Engineering curriculum should centre on the imparting of broad and widely applicable principles of analysis and synthesis.

10. DR. ALFRED C. INGERSOLL (U.S.A.) : *Teaching of Mathematics for Engineers at the California Institute of Technology.*

At Caltech we receive the incoming student at about the level of your matriculation, that is at the age of 16 or 17 years. In the following 4 years, then, we can not hope to produce a finished professional engineer, or even a journeyman. The best we can hope to do is to produce an apprentice with a good kit of tools. Mathematics is fundamental in the kit and we require the following of all our engineering students:

1st and 2nd year: (taught in math. dept.) Differential and Integral Calculus, Analysis and Ordinary Differential Equations.

3rd year: (taught in engineering dept.) Vector analysis with application to fluid flow, heat flow and electrostatics. Ordinary differential equations with series solutions, boundary value problems and Orthogonal functions, Bessel functions, Fourier series, Legendre polynomials. These are all subsequently applied to the solution of partial differential equations of physics, such as vibration of string, beam or membrane, fluid flow, heat flow, soil drying and consolidation.

In the last term of the 3rd year the student can select between complex variable and statistics. We feel statistics is important especially for the civil engineer in connection with hydrology problems of rainfall and flood frequency analyses.

11. PROF. M. K. GANGULI (Poona) :

The speaker attempted to focus attention as to how Mathematics and Statistics come as an aid for solving various engineering problems. Generally before recommending any unconventional designs in any engineering problems the performance of the proposed design is investigated by different experimental techniques. The techniques have got certain merits and demerits and it is always found desirable in such cases to make an analytical approach for a complete solution, if possible, which in turn greatly increases confidence in the results. Though on many occasions the exact solution of the many unknowns involved in the problems cannot be obtained but a very good approximation of the same will generally be available. Statistics as a science of approximation steps in here to render help.

With the help of certain illustration, speaker demonstrated how and when these approximations can be made. Numerical analysis as a powerful tool was thus shown necessary for every day working of the engineers and it is to be hoped, the speaker, remarked this particular branch of mathematics and statistics will find a prominent place in the teaching syllabus for the engineering course.

SECTION OF STATISTICS

CHAIRMAN : DR. V. G. PANSE (New Delhi)

Problems of Co-Ordination of Statistical Activities

1. P. V. SUKHATE (New Delhi)

1. DR. P. V. SUKHATE (New Delhi) opened the symposium by referring to how co-ordination is effected in the U.N. system of official Statistics. He surveyed the present state of co-ordination in India and discussed the various problems it has raised. He also referred to co-ordination in research in mathematical and applied statistics. In the course of his speech he made the following points.

- (a) The U.N. system is a decentralised system in which the specialised agencies collect statistics in their respective fields from member nations.
- (b) Co-ordination is confined to the work of standardising concepts and definitions and is the responsibility of the specialised agencies in their respective fields.
- (c) Co-ordination among the specialised agencies is brought about through a Committee on co-ordination whose Chairman is the Director of the U.N. statistical office. It is confined to collecting statistics not collected by the specialised agencies and publishing an abstract covering all fields.
- (d) The application of the U.N. statistical system to conditions in India needs modification to bring it in line with the federal structure of the Government and the division of responsibilities between the centre and the states.
- (e) Indian system is going through large and rapid changes. It is decentralised at the centre. Co-ordination is brought about by C.S.O. (Central Statistical Organisation) & N.S.S. (National Sample Survey).
- (f) The field of co-ordination of C.S.O. extends to (i) vetting proposals from Ministries and (ii) publication of an overall abstract of statistics; but it is believed that it will be further extended to cover other fields like recruitment, training, advising state Governments etc.
- (g) Co-ordination to be effective requires impersonal, impartial and humble attitude. It is therefore important for the CSO to avoid giving impression that it is a controlling body sitting in judgement as it were on the proposals of the Ministries. CSO must also not be a competing office. Those requirements are best met if the responsibility for co-ordination in individual fields is as in the U.N. system left to the Ministries concerned to be carried out in consultation with the states and simultaneous consultation with the CSO.
- (h) The N.S.S. constitutes another co-ordinating machinery at the centre. It is set up to collect statistics from the primary source in all fields on a continuing basis. It means that the states' responsibility of collecting statistics from the primary source, even in the field of current statistics is being duplicated by the centre.
- (i) The control at present exercised over the Ministries by the CSO and the encroachment of NSS on the primary function of the states are a pointer to a swing in favour of strong centralisation.

- (j) In giving consideration to research statistics, it is important to recognise that statistical method is a tool and cannot be divorced from its field of application. Thus research statistics in agriculture must be the field of the I.C.A.R.
- (k) There is an urgent need to work out the requirements in terms of men and money, of research statistics, for the centre and its counter-parts in the states. There is of course ICAR statistics branch to co-ordinate statistics in agricultural research but the money spent is negligible. There is need for a similar organisation, attached to CSIR.
- (l) Research in mathematical statistics is the function of the Universities but little has been done to co-ordinate their activities.
- (m) Research and training in applied statistics seems, with exception of agriculture, all centralised in one Institute. There is therefore a danger that other Institutes may not get resources to develop.
- (n) Co-ordination presumes fair distribution and decentralisation of work. The problem is basic and debated with heat everywhere. Its solution demands vigilance on the part of statisticians at all time.

2. Dr. K. S. Rao (Bombay)

The main demand for collection and presentation of data is for aiding decisions arising in economic policy and planning. The decisions may be those of individuals, corporate bodies or governments, central and state. The best decision in any case depends on the extent of operational freedom available to the decision making body. The frame work within which such freedom is available changes from time to time. It is a peculiarity of the economic phenomena that while the frame work influences the best decision, the decision taken again influences the frame. The state of an economy, for example, determines the economic policy of the government and the policy adopted influences the state of the economy.

For making a decision it is not necessary that details about all the minute aspects of the frame should be known. Since economic variables are highly interrelated, in the presence of a few relevant factors others provide no appreciable explanation. It is therefore a fortunate circumstance in quantitative economics that a study of a few relevant variables constitutes almost a study of the entire frame within which a decision is to be made. But since these variables are interrelated, the decision is to be based on a model which recognises explicitly the interrelated nature of the variables. Any neglect of this precaution does not lead to an optimal decision.

The estimation and use of economic models for economic policy depend on the approximation permitted in the closeness of fit required between a model and data and and on the techniques of statistical inference available. It is with the help of such techniques that we can identify an optimal decision.

If the economic decisions at a time or sequence of time points of the central government or of state governments, for example, are unco-ordinated, each decision may be identified as the best both from the point of the specification and estimation of the model used. But taken together they need not represent the best set of optimal decisions. On the other hand they may be mutually contradictory to one another. This will arise because of lack of independence between the frames within which decisions are made and between the statistical tests used for identifying optimal decisions within each sector.

Economic design: From the foregoing it is evident that there must be a comprehensive economic design for the collection, analysis and interpretation of data to meet the needs of a coordinated economic policy.

An economic design depends essentially on the objectives of economic policy. The targets of economic policy lead to a search of instruments for attaining them. A study of the interrelationships between targets and instruments is in terms of economic models. They must be formulated in a form identifiable by actual data. The study of models can be made in terms of only data that are available or can be collected. The form in which the data are to be collected is determined by the form in which the models are required. It is thus ultimately the objectives of economic policy and economic decisions in general that determine the economic design for the collection and use of data.

Statistical design: While the nature of data to be collected is a matter for economic design, the extent to which they should be collected and the method of collection is a matter for statistical design. Whether they should be collected in the form of time series or whether they should relate to one interval of time or whether they should be collected by complete enumeration or by sampling and if so by what procedure of sampling and size of sample, are all matters for statistical design. Statistical design depends on the statistical techniques of collection and interpretation and the precision with which the statistical techniques enable the measurement of economic relation with the existing machinery for economic administration of the country.

3. DR. A. R. SEN (Lucknow)

The real problem of co-ordination of statistical activities arises in decentralised statistical systems. The main function of a co-ordinating agency is to develop a certain degree of uniformity and comparability in concepts and terminology in the different subject matter fields with a view to increase the over-all efficiency of the decentralised statistical systems.

Some of the specific functions of a central co-ordinating agency were outlined and satisfaction expressed at the progress made in this direction at the two Joint Conferences of Central and State Statisticians held in New Delhi during 1951 and 1953. A research unit in each State and at the Centre similar to the Indian Council of agricultural Research is needed for proper co-ordination of research in connection with planning and conduct of surveys.

The functions of a co-ordinating agency should be restricted to co-ordination of statistical activities only and the agency should not have administrative control over the statistical offices of the decentralised systems. The speaker warned against the danger of reducing the standard of State statistics for the sake of All India comparability.

4. DR. P. K. BOSE (Calcutta)

Statistical activities are mainly of three types—(1) compilation of data, (2) use of statistics as a tool and (3) teaching and research. Co-ordination in its proper sense should be effected at each level. Some progress has been made in this direction so far as activities of first type are concerned, by the establishment of the Central Statistical Organisation, and also a little at the second level, e.g. some uniformity of agricultural experimental designs and analysis has been achieved by the I.C.A.R. There is, however, practically no co-ordination in teaching and research and the need is urgent that standardisation of syllabi and courses of study be taken up. It is important to note that

the tendency for centralisation and monopolisation is harmful to any effective scheme for co-ordination.

5. Besides the above speakers, Drs. D. V. Rajlakshanam, N. K. Bose, A. K. Gayen and Messrs T. Ghosh, K. C. Basack and K. C. Chanda also participated in the discussion.

6. In concluding the discussion, the Chairman remarked that the need for co-ordination was agreed on all hands. The problem was how to achieve it. Any scheme for co-ordination that is imposed from the top is not likely to succeed, but what is needed is a co-operative attitude and development of healthy conventions as one goes ahead. As an example of co-ordinated efforts he cited the Farm Management Surveys under the Planning Commission where the State organisations worked independently, but they met together to formulate a uniform programme of work, to discuss the progress made and so on. He further observed that in the initial stages of co-ordination some duplication of work might be allowed, and this might be put to advantage by trying to extract that amount of information which is revealed only from the comparison of the different results. He also emphasized the need of co-ordination in Universities. He suggested that the University Departments of Statistics should attach to themselves some branches of applied work, which would help directing their study and research to practical problems.

Demographic Problems

1. DR. U. S. NAIR (Travancore)

Opened the discussion. He defined the scope of demography as comprising not merely statistics of births, deaths, etc. depicting the condition of the population but covering all things relating to social, economic and cultural activities of different groups of people in the population. Accordingly problems of demography may be studied under four broad heads: growth, distribution, social aspects and cultural aspects. He confined himself to discussion of problem of growth so far as his state, Travancore was concerned. But he presumed that the points he would make out would have a wider field of applicability. In order to study growth of population one must have statistics of births, deaths and migration besides a census of population. In India, and particularly in his own state, birth and death registers are very inadequate, and there was need for collecting such data by sample survey. Then Dr. Nair referred to one result coming out of the analysis of birth statistics, namely that number of first born children to mothers with ages above twenty was considerably less than to mothers aged less than 20 years. This seems to suggest that increase in the age of marriage to twenty may have significant effect on population control. He next discussed the result of analysing the number of births recorded for mothers who take fish and those who do not take fish. The conclusion appears to be that fish-eating (and perhaps protein intake in general) has the effect of increasing the rate of reproduction.

2. Prof. N. K. BOSE (Calcutta)

Anthropologists realise the great need of more intimate co-operation with Statisticians.

There are various productive organisations prevalent in different parts of India to-day: hunting and collecting with axe cultivation; agriculture by means of the plough for local consumption coupled with village industries run by human or animal power, commercialized agriculture coupled with mill industries, and so on. It would help an-

thropologists immensely if demographers could find out the carrying capacity of each system of production per square mile of land, taking a certain standard of living as the common point of reference.

A word of caution is needed here. When it is claimed that the present industrial system supports more people per square mile at a high standard, this is often calculated on the basis of the area of residence (or occupied area). Actually such a group may draw their requirements from vast stretches of land like Africa, Argentina or Australia. While calculating the carrying capacity, it is imperative that these additional areas should also be taken into adequate consideration.

We know little about the net reproductive indexes of various strands of the Indian population. It is usual to lump together all classes in India while calculating things like average expectancy of life and so on. It is suggested that the different strands of the Indian population should be treated separately for such purposes. In this preliminary analysis of the population, anthropologists can be of some service to demographers.

With regard to the question of birth-control, attention may be drawn to the work of Dr. S. N. Sanyal (Calcutta) as well as of others in connection with the oral administration of either compounds which are anti-vitamin E in their function, or which physiologically interfere with the reproductive cycle in the human organism. The hypothesis of De Castro that a high protein intake reduces the rate of reproduction, as in the Scandinavian Countries in comparison with Formosa for instance, needs careful examination in this connection.

While calculating the reproductive index again, Professor Nair has divided the women of Travancore-Cochin on the basis of the decimal system into several age-grades. It is suggested that the age at which girls attain puberty, as well as the age at which menopause sets in be taken into consideration while classifying subjects into age-grade for purposes of reproductive life. For this varies from one group to another, and may also vary within the same group in course of time if habits of life change in a significant manner.

3. Mr. K. C. BASACK (Calcutta)

Expressed the view that high birth-rate and rapid growth of population should not cause anxiety to Indian demographers. He pointed out that in its earlier stages industrialization in U.K. accounted for something like 15% population growth and further reduction of mortality. He said that even in India to-day there were some regions where there was dearth of population for cultivation. He felt that in view of the Development programme there was no need of reducing population in India.

4. Dr. V. G. PANSE (Delhi)

In explaining a point raised by the previous speakers, referred to the limitations of sample survey and census data in supplying certain types of information. As for example, if one has to study whether fish-eating has any effect on the reproduction rate, this information can be had only from controlled experiments with fish-eating and non-fish-eating populations, thereby eliminating all other major factors likely to affect reproduction.

5. Besides the above speakers, Messrs M. V. Jambhunathan and Sundararajan also took part in the discussion.

6. The Chairman concluded the discussion by making out the following points:
(1) Statistics was greatly needed in sociological studies 2) Anthropologists who conduct

study over small groups of people can throw much light on demographic problems and 3) the problem of population control is to be considered non-politically for Indian conditions.

Statistical Method in Genetics and plant Breeding

1. MR. V. N. AMBLE (Now Delhi)

Opened the discussion. He said that the applications of statistics to the study of inheritance of quantitative characters in animals and to the planning of animal breeding programmes have been, in India as elsewhere, fewer and much more recent than in plants. It is only in the last few years that at some of the State livestock farms work is in progress on systematic lines to progeny test the series and make selection on an objective basis. In the I.C.A.R., studies of available data at major livestock farms pertaining to breeding have been taken up with a view to making a quantitative evaluation of the policy of breeding that was followed and its consequences. Such studies help in giving guidance to the planning of future breeding programmes and in assessing the situation in respect of the genetics of the particular traits studied. They are at the same time of value in providing the most effective evidence to bring home to the breeders the need for planning and for a proper appraisal of the progress of work.

Problems in animal breeding are far more complex than in plant breeding for a number of reasons. Selfing, the closest form of inbreeding, which is so powerful a procedure in many plants such as wheat in quickly obtaining a so-called "pure-bred" strain, is out of question with animals. In animals we have to deal with the more complicated problems of biparental progenies. In large animals moreover the rate of reproduction is low and some of the characters of major economic importance such as milk production are sex-limited. All these add to the complexities of the problems.

Any programme of breeding involves two steps: (i) the selection of individuals to be used as parents and (ii) the choice of the mating system. Selection is the most important force in changing the frequency of a gene in a population and in thereby increasing the favourable genotypes. The mating system, while not affecting the gene frequency in the absence of selection, changes the proportions of different genotypes in the population and permits more, or less, effective scope for selection. Statistical considerations and methods play an important role in the correct choice in respect of both these components of a breeding plan and in evaluating the consequences of the adoption of any plan.

Selection can be effective in bringing about a change in the average value of a population in respect of a trait only when genetic variation for that trait exists in the unselected population. It becomes extremely important therefore to assess the genetic variation existent in a population. Secondly, selection in such a population will be effective in bringing about improvement to the extent it is made for genetic or real breeding value of the individuals. On the other hand, selection has necessarily to be based on phenotypic or observed values. The criterion or index for selection has to be therefore so chosen that it is correlated to a maximum extent with the genetic value of the individual.

A statistical comparison of the average performance of the progeny with that of their own dams may be seen to be a test of whether the sire used was genetically of a potentiality superior to the average of the dams used. An estimate of the breeding value of the sire or the sire index may also be calculated from the same data. The for-

mulation of such an index, estimation of the standard error of the estimated index, possible corrections for herd to herd variations etc. and finally the combination of information from the pedigree records, records of sibs and other collateral relatives and from the progeny into an overall index, are all problems in which statistics is involved.

The data which furnish the progeny testing of the sires also enable us to obtain a rough estimate of heritability. The choice among alternative methods of estimation such as regression of daughters on dams and half-sib correlation, the possible corrections for environmental correlations and for the mating system, the manner of dealing with the records of more than one daughter per dam, and more than a single record per animal, such as several lactation records, are again problems for the application of statistical theory.

With the available information on the relative worth of sires and the approximate extent of genetic variation in the parent generation, the stage is set for the next phase of the breeding plan. What should be the rigour of selection among the males and among the females? What should be system of mating to be adopted? Which policy of selection—selection at what stage, and at each stage at what intensity, and based on what criterion—would be the most efficient and economic? The answer will obviously depend upon the genetic gains to be expected and the cost of maintenance corresponding to each policy. Solution to these problems can be attempted only with the aid of diverse tools of statistical science.

Finally, the most important question of all, viz., what should be the overall pattern of the breeding plan depends for its answer on the unravelling of some of the outstanding problems in statistics of genetics. These are to put briefly : detection and estimation of the magnitude of variation due to gene interactions or epistatic variations; detection and estimation of the extent of overdominance or superdominance as distinct from incomplete or complete dominance; and the estimation of the interaction between heredity and environment. If epistatic variation were important, some sort of line-breeding programme aimed at obtaining the optimum combination of homozygous phases of the factors involved might be best. On the other hand, if overdominance were present, some such programme as recurrent selection on the basis of combining ability with a tester cross or reciprocal recurrent selection may be useful. If interaction between heredity and environment were high, it would be necessary to evolve distinct breeds for different ecological niches. We could expect to obtain answers to these questions in breeding only with further and intensive applications of statistical theory to animal genetics,

2. DR. S. S. PRABHU (Izatnagar)

Dr. Panse in his presidential address had correctly pointed out that rapid headway made in the application of statistical methodology to genetics in foreign countries is to a large extent due to the existence of flourishing departments of genetics there. In India, on the other hand, we are still in the formative period; the need for separate chairs in Genetics at the Universities though felt, has not yet taken shape. While this is the position in genetics, in statistics we have established schools of thought. There is no doubt that much can be achieved through a healthy co-operation between the statisticians on the one hand and the animal husbandry workers on the other. Statisticians would be particularly useful to the animal workers at the planning stage and later in interpretations of the results, while the animal husbandry workers could keep the statisticians abreast with the peculiar nature of the problems they had to tackle and assist them in evolving suitable tools.

Mr. Amble has covered most of the ground in animal husbandry where statistics could be profitably employed. He has also described some of the methods in detail. I would confine my remarks to the special problems that one encounters while trying to apply statistical methods developed largely from plant experimentation to problems in animal breeding. Unlike in plants the estimates of an economic character in animals have to be evaluated through records spread over days, months and even years. Thus while yield of grains for example is obtained in one observation in plants, milk yield in animals for instance is spread over days, lactations and years of productive life of an animal. This makes the effect of environment a major factor in their cases. When we consider that the methods of management and animal husbandry practices also largely affect yields in animals, the problem becomes still more complicated. In India, with our variety of managerial practices, differing climatic conditions and breeds, it would be clear that environment is bound to exert an enormous influence on yield data of animals. It would therefore be necessary not only to find a suitable statistical yardstick to correctly estimate the various economical traits which one would like to study, but also separately find their relative heritability under the special conditions met with here. The need for such studies was clearly recognised by the FAO conference that met at Lucknow in 1950 to consider the problems of breeding livestock under tropical and sub-tropical conditions. Since cost of maintaining animals is an acute problem in any studies relating to animals a suggestion was thrown that possibly the facilities existing at the Key Villages started under the first Five Year plan might be profitably explored. An organised effort at this stage to see that the records kept at these centres fulfill the minimum statistical requirements, may in course of years produce valuable information that could be utilised in evolving suitable statistical tools and in answering many problems facing the animal husbandry workers in India to-day.

Finally, the lack of co-operation which is apparent but not real, between the statisticians and the animal breeders was ascribed to lack of understanding of each others' backgrounds and terminology. The language employed by the statisticians is at times obscure to the experimenter, while the details of the experiment itself and its finer aspects are not readily understood by the statisticians. An understanding of each others' "language" will pave the way for a healthy co-operation in the solution of the numerous problems that an animal husbandry worker has to face in India to day.

3. MR. S. D. BOKIL (Indor)

Apart from genotypic variability, factors such as the number of gene pairs segregating, amount of environmental variability etc. are of importance to the progress by selection in which a plant breeder is interested. The effect of environmental variability on progress by selection is seen from the following figures of advance obtained theoretically by 10% selection in a self-fertilized F_2 plant population represented by genetic models consisting of 2, 8 & 32 equal factors without dominance producing unit genetic variance in F_2 , for various ratios of genetic & environmental variabilities.

No. of factors	Ratio of genetic and environmental variabilities		
	1 : 4	3 : 4	5 : 4
2	0.779	1.138	1.298
8	0.783	1.147	1.306
32	0.784	1.148	1.308

Hence while judging materials for selection the plant breeder should estimate the amount of environmental as well as genetic components of observed variation.

It will also be noted from the results that the number of factors seems to have a

very small effect on the immediate progress by selection. However it is known to be important from the point of view of continued selection. This number can be conveniently estimated by method given by Dr. Panse (Jour. Genetics, 1940).

4. MR. J. S. PRUTHI (Mysore)

In any field of science, in general, and biological sciences in particular, an able statistician undoubtedly plays a key or pivotal role and has three important contributions to make, viz. (i) to advise on the general statistical principles underlying the particular assay, (ii) to plan experimental designs which are likely to give most useful and reliable results, (iii) to analyse data so as to make the best use of the entire data collected. Before undertaking any designing or planning of any experiment, it is incumbent on the part of the statistician to have a fairly thorough grasp of the technical subject in hand and the practical difficulties of the field worker. The proper function of a statistician in scientific research and technology is, therefore, no longer merely that of analysing and summarising large bodies of experimental data; he is required to advise on the plan and economy of each investigation, in the light of its operational efficiency.

Further, it is usually remarked that the plant breeders confine their studies only to physical aspects like yield of crops, size and shape of individual fruit etc. If at the conclusion of these Agri-cum-horticultural experiments, the fruits and vegetables are passed on to the next door chemist, physiologist and technologist, they will be able to report on the suitability or otherwise of the particular variety of fruit or vegetable from their view-point, and this should be of direct practical interest to the breeder or the grower. It is hardly necessary to emphasize that the services of a statistician will again be needed in each of these fields and then the variety of fruit which turns out to be an all rounder, i.e., which is nutritious, and delicious, can stand transport, storage and processing, will certainly fetch a reasonable premium over other varieties which lack these characters. In a nutshell, a close collaboration between a plant-breeder, a statistician, a nutritionist and a technologist with a thorough understanding of each others' difficulties and view-point, will definitely result in the production of maximum of useful and reliable results in the minimum possible time.

5. DR. S. BHADURI (Calcutta)

In experiments with clover and lucerne grown in test tubes and inoculated with suitable strain of *Rhizobium*, the numbers of nodules produced and dry weights of tops and roots determine the nature of the effect of symbiosis between the bacteria and the legume host plant. The heterogeneity of the data was partially controlled in the experiment by controlling the concentration of bacteria in the inoculum, volume of the media and rates of sowing; but the result may still be vitiated by the practical difficulty in limiting the genetical variability of the plant. Further, heterogeneity results from the interaction of this plant factor with treatment effects when replicated factorial designs are made.

Distribution of a large amount of data of uniformity trials on numbers of nodules and dry weights of plants showed that the population is markedly skew in nature.

Two varieties of clover plants 'g' and 'x' were sown singly or each in association with another plant of the same variety or a different one in test tubes and were inoculated with three bacterial strains A121111, 211 and f12. The plant variety 'g' was known to give an effective symbiosis with A121111 and 211 and the variety 'x' which differed essentially from 'g' only on being homozygous for a recessive gene, gave an effective symbiosis with A121111 and ineffective symbiosis with 211. Both

varieties, however, gave an ineffective symbiosis with f12. The experiment was designed factorially with two varieties of plants in three combinations of spacing and grown in presence of each of the three strains of bacteria in 8 replicates randomised in blocks. Analysis of variance showed that standard errors of nodule numbers and of dry weights were 36.01 and 33.88 per cent respectively of the general means. Treatment variances were tested for homogeneity by Bartlett's method to show that there were real differences between treatment variances and as such the comparison of means with pooled estimate of error is incorrect.

Non-normality of the data was evident and logarithmic transformation was resorted to for efficient comparison of the treatment effects.

6. DR. S. M. SIKKA (New Delhi)

also took part in the discussion.

7. DR. T. S. RAGHAVAN and DR. S. GOVINDASWAMY (Coimbatore)

The inter-relationship between genetics and plant breeding has been emphasised. From the realm of art plant breeding has passed on to the realm of an exact science with the re-discovery of laws of Mendelian heredity at the turn of the century. In the earlier investigations into the field of heredity, data were gathered by methods considered purely genetical. With the discovery of the presence of the genes, the hereditary units, genetics has come to assume a new complexion. Correlation of data obtained by genetical procedure with observations made by cytological technique, has become the rule in present day practice. This dual approach—“cyto-genetics”—involves a sound knowledge of statistical methods.

Obviously the methods followed in sugarcane breeding are of necessity a consequence of its cyto-genetical features. The fundamental fact to remember about sugarcane in this connexion is that as a breeding material, it is different from the other crop plants. This, of course, is due to its genetical constitution which in its turn is dependent upon its evolution. It is a highly heterozygous polyploid complex with a large reserve of lethal genes which especially in the officinarums are responsible for there being practically no selfed progeny. It is the clonal propagation that has made it survive the competition. The presence of diploid parthenogenesis in most of the pollen sterile forms adds to the complexity. There is therefore very little that could be done for purifying sugarcane. Thus inbreeding and pureline selection are of no avail in sugarcane breeding. The vagaries exhibited by sugarcane as a breeding material and their cytological basis have been described. Phenomena such as elimination of chromosomes *en bloc*, semblance of dosage effect of genes in some crosses and its absence in others, irregular phenotypic expression not easily explicable by established cytological causes, the presence of some sort of cytoplasmic inheritance in some crosses, non-segregation of parental characters due to autosyndetic pairing of the chromosomes—these have been indicated. For genetical studies sugarcane is not a favourable material.

The data that have been gathered have been subjected to statistical analysis and they have been presented. For instance in some crosses, the reciprocal differences with reference to particular characters, have been found to be statistically significant indicating the presence of an inheritance which is based upon an inter-action of the genes with the maternal cytoplasm. This has been found to apply even in cases where economic characters like yield and sucrose have been taken into consideration,

Some of the characters like tiller number, height, leaf length and width, appear *prima facie* polymeric in their inheritance. But subjecting the collected data to statistical analysis, it was found that they did not conform to the expectation.

Similarly when single qualitative characters are taken for genetical analysis, it was found that they did not conform to their monogenic or digenic inheritance. This is according to expectation, remembering that sugarcane is genetically a highly impure material, and the chances of establishing homo-zygosity are practically nil, owing to inherent cyto-genetical complications.

8. The Chairman wound up the discussion by calling attention to some of the points raised by the previous speakers. He explained the usefulness of statistical applications in plant and animal breeding from the point of view of optimum utilization of resources. He further observed that for fruitful application of statistical methods statisticians should know the problems and difficulties of the breeders while the breeder also must be familiar with the statistical approach and that mutual understanding between the two groups of workers was essential for rapid progress in the task of improving our domestic plants and animals.

SECTION OF PHYSICS

Chairman : DR. R. K. ASUNDI (Banaras)

VIII. Molecular Spectra and Molecular Structure

1. DR. S. S. DHARMATTI (Bombay) : *Nuclear Magnetic Resonance and Molecular Structure*

During the last five years the technique of nuclear magnetic resonance has considerably improved and has thereby made it possible to attain a very high degree of sensitivity and resolution. The development of very high precision nuclear induction spectrometer has now a resolution better than 1 part in 10^7 and with the use of such a high resolution spectrometer, nuclear magnetic moment measurements have proved in recent years to be effective means for studying numerous molecular and chemical problems. Nuclear magnetic moments and related measurements when suitably applied give useful information regarding the locations of atoms and electron density distribution in molecules, the nature of molecular bonds, chemical exchange, crystal structure and other variety of important chemical and structural problems. These and other allied problems arising out of the recent studies of nuclear magnetic resonances by various workers in this field will be reviewed and discussed.

2. DR. M. L. N. SASTRI (New Delhi) : *The Luminescence of Organic Molecules*

The luminescence of organic molecules in relation to molecular structure is briefly reviewed. Fluorescence spectra of aromatic hydrocarbons, and the effect of substitutions in the ring systems are discussed. The spectra of mono-, di-, and tri-substituted benzenes are compared. It is found experimentally that 1, 3, 5-trifluorobenzene vapour irradiated by light from Fe, Mn, Ni, Cd, Cu, Bi and Al sparks as well as from a mercury arc did not give any fluorescence spectrum. The probable causes for the quenching of fluorescence in this molecule as well as in chlorobenzene are discussed. The structures of these two molecules are compared with other mono- and symmetric tri-substituted benzenes which are known to yield fluorescence.

3. DR. D. D. PANT (Nainital) : *Fluorescence spectra of uranyl Salts*

The spectra of Uranyl salts at ordinary temperature consist of broad and diffuse bands spaced at regular interval of about 860 cm^{-1} in fluorescence and of about 700 cm^{-1} in absorption. The fluorescence is observed in uranium salts containing the uranyl group (UO_2) and the spectrum is independent of the frequency of exciting radiation. At low temperatures a large number of line-like bands is observed. The resonance band which is common to both fluorescence and absorption spectra has in several salts a

violet component with a frequency separation of about 150 cm^{-1} . These two bands show an interesting change in their relative intensity in fluorescence and absorption. The duration of fluorescence is of the order of magnitude of 10^{-4} sec. and no photo conductivity is observed. The fluorescence spectra also do not show Zeeman effect. The uranyl ion (UO_2) is paramagnetic and in uranyl sulphate the ion is reported to show paramagnetism increasing with temperature. The Raman and infra-red investigations have shown that UO_2 has three vibrational frequencies at 860, 930 and 210 representing symmetric, anti-symmetric and deformational vibrations. The molecule has a bent structure according to these data, although X-ray investigations are in favour of a linear molecular structure.

The fluorescence spectra are due to transitions from a single vibrationless excited electronic state to the various lower levels and all the three vibrational frequencies appear to take part. There is evidence for the ion having two close electronic levels forming the ground state. Analysis on this basis has also been attempted. The question of completely satisfactory analysis, origin of fluorescence and sharp bands, dependence of intensity of fluorescence on water of crystallization in the salt and several other problems are yet unsolved.

4. DR. D. SHARMA (Allahabad) : *Recent advances in Diatomic Molecular spectra*

In addition to the more accurate determination of molecular constants of diatomic molecules by using better resolutions, altogether new techniques have recently been applied to the study of molecular spectra. The use of microwaves and magnetic and electric resonance spectra have not only enabled the determination of those molecular constants which could not be found by the ordinary spectroscopic methods, but have also supplied useful information about nuclei.

To explain the spectra of planets and stars where the conditions are considerably different from those existing in the laboratory, various devices of excitation have been developed. In the investigation of the forbidden transitions in absorption use of multiple reflexion arrangement to increase effective path lengths has been of immense use. Forbidden band systems have also been excited in uncondensed discharges run in the presence of a rare gas like A or He at reduced pressure.

The study of the absorption spectra of radicals, along with the investigations of the spectra of flames, has contributed a good deal towards understanding the mechanism of combustion.

Recently a number of band systems involving transitions between terms of high multiplicity have been observed and studied.

5. DR. M. R. PADHYE (Bombay) : *The lowest triplet states of some Aromatic Hydrocarbons*

Recent theoretical work on the energy levels of aromatic hydrocarbons in the polycyclic series has focused attention particularly on the experimental assignments of transitions in this series. In the case of anthracene, the lowest triplet level was reported at

14,700 cm^{-1} (Lewis and Kasha, 1944). Recently, C. Reid in three papers has offered three different lines of indirect evidence against the earlier assignment.

We have re-examined the anthracene lowest triplet level by two independent direct approaches :

(a) the phosphorescence spectra at 77°K of anthracene and seven variously halogenated anthracenes.

(b) the single-triplet absorption of 9,10-dichloro and 9,10-dibromo-anthracene using long optical paths.

These experiments have led to the certain confirmation of the earlier assignment of 14,700 cm^{-1} as the height above the ground state of the lowest triplet level of unsubstituted anthracene. The results are unambiguously confirmed by the perturbation experiments reported by McGlynn and Kasha.

The work was done in the Department of Chemistry, Florida University in collaboration with S. P. McGlynn and M. Kasha under a contract between the office of Naval Research and the Florida State University.

6. DR. V. RAMAKRISHNA RAO (Waltair) : *Spectra of Rotational Isomers*

Investigations in the Raman and Infrared spectra established the existence of two or more isomeric forms in molecules like substituted ethanes, Oxalyl chlorido etc. Observation of more Raman lines particularly of the polarized type, than can be expected for one form alone, led to this suggestion. Also the coincidences between the Raman lines and the Infrared bands at room temperature were larger than expected. In the low temperature Raman spectra only a few lines persisted with undiminished intensity. These lines were attributed to the TRANS form (C_{2h}). At ordinary temperatures, either the CIS(C_{2v}) or the GAUCHE(C_2) forms co-exist with the stabler TRANS form, giving rise to their own spectra. A systematic increase in the intensity of the lines corresponding to the CIS or GAUCHE forms at the expense of those due to the TRANS form indicates that with higher temperatures more molecules change over into the CIS or GAUCHE forms. From measurements of intensities at various temperatures the potential barrier separating the two forms was estimated to be $\sim 3\text{KCal/mol}$. This small value is responsible for the ready transformation at ordinary temperatures thus making the chemical separations of the isomers impossible. No satisfactory evidence is yet found for the rotational isomers from the U.V. absorption spectra.

IX. Nuclear Structure

Chairman : DR. R. K. ASUNDI (Banaras)

1. DR. B. PETERS (Bombay) : *Unstable Particles in high energy Nuclear Physics*

The paper will summarize the existing information on various unstable particles and discuss the known properties of both heavy mesons and hyperons. It will also

deal with the experimental techniques which have been developed in recent years for the study of these rare and short-lived forms of matter.

2. DR. S. BISWAS (Bombay) : *Observations on Heavy Unstable Particles*

Heavy unstable particles observed in emulsion blocks composed of stripped emulsions, exposed in the stratosphere have been analysed. The production, mass estimation, decay scheme and the interaction of these particles are discussed.

3. DR. S. JHA and MR. R. K. GUPTA : *The Excited States of RaE*

A proportional Counter Spectrometer with a single channel analyser, has been set-up. Electromagnetic radiations from RaD have been studied. Peaks were observed at 47 Kev, 16 Kev, 13 Kev, 11 Kev, 8 Kev and extremely weak ones at 23 Kev and 36 Kev. 47 Kev and the Bi LX-rays are well known. 8 Kev peak is shown to be due to the material (brass) of the counter. The peak at 23 Kev is due to the build up. The significance of 36 Kev peak in the light of recent calculations and experimental results is discussed.

4. DR. E. KONDAIAH : *Excited Levels in C¹²*

Separated B⁺ target (100 Kev thick for 1 Mev deuterons) is bombarded with 1050 Kev deuterons obtained from the Canberra Cockroft-Walton accelerator. Nuclear emulsion plates (200 μ thick) have been exposed to the outgoing neutrons at different angles with respect to the deuteron beam. The plates have been processed using the temperature development technique. Recoil proton tracks falling within 10° to the incident neutron direction have been measured, and the neutron spectrum has been obtained. The neutron spectrum thus obtained shows some new levels in C¹² in addition to the levels hitherto reported.

5. DR. A. MUKERJI (Bombay) : *Low-lying Energy Levels in the Region N or Z = 20 to 38.*

The low excited states of the odd A nuclei in the region N or Z = 20 to 38 bear out many of the salient features of the nuclear models. Of particular interest are the first excited states of some of the scandium isotopes and of Cu⁶⁵. Experimental results obtained with a scintillation γ -ray spectrometer are discussed.

6. DR. K. S. SINGWI and DR. L. S. KOTHARI (Bombay) : *Thermal Inelastic Scattering of Cold Neutrons in Polycrystalline Solids*

A general theory of the influence of thermal motion on the scattering of slow neutrons in polycrystals is discussed. Expressing the temperature displacements of the lattice points as a sum of emission and absorption operators, the matrix element for the transition of a neutron from an initial to a final state through the absorption of a single

phonon is deduced. The theory is then generalized to take account of multi-phonon processes. Our method gives an alternative and a simple proof of the Debye-Waller factor.

General expressions for both the incoherent and coherent cross-sections, corresponding to a phonon process are derived. The latter, hitherto not treated rigorously, is examined in detail. It is shown that it can be expressed as a sum of two terms, of which the main term, apart from a constant, is identical to the expression for the incoherent part and the other is a correction term. Both terms are put in "Placzek" form and for cold neutrons explicit expressions are obtained for the cases: (i) $M \gg 1$ and $T/\theta \gg 1$, (ii) $M \sim 10$ and $T/\theta \geq 0.5$.

Numerical results for magnesium, aluminum, iron, lead and beryllium are discussed and compared with experiment. The agreement is found to be satisfactory.

7. DR. B. V. THOSAR and MR. M. C. JOSHI (Bombay): *Gamma-ray Energies in the Decay of Cs¹³⁴*

Photo-electric conversion spectrum of gamma-rays in the decay of Cesium-134 of 2.3 years half-life, was studied with a Siegbahn-Slatis Beta-ray Spectrometer, using a strong source and thick lead and uranium as radiators to bring out weak lines. In addition to seven gamma-rays reported previously by most of the observers, two gamma-rays of energies 467 Kev. and 1401 Kev., have been recorded. The former of these is shown to arise from one of the level-schemes already proposed. The latter, which is a weak one, is energetically possible as a cross-over transition but this is not consistent with the spin-assignments made in previous work. The more recent work of J.M. Cork and others on this isotope is also discussed and coincidence spectrometric measurements, now in progress, are described.

8. DR. K. G. VOHRA: *The Measurement of Weak Radioactivities and an Investigation on the Radioactive Content of Air in Bombay*

The collection of radioactive ions and the detection of alpha activity with proportional counters, have been used for the study of weak radioactivities, and especially the radioactive content of the air. The ion-collector consists of a long cylinder, with a small negatively charged co-axial rod on which the collection is made. A streamlined flow of air is obtained through the collector. The proportional counters are filled with hydrogen and argon at pressure of 4 to 5 cm. hg. The high voltage supply used with the counters gives a stabilisation of 0.1% for normal fluctuations in the supply-mains. Bias plateau curves of the proportional counters have been studied. A high gain linear pulse amplifier with a discriminator, a scale of 8, and the necessary recording circuits have been used with the counter.

With this apparatus measurements have been made with the weak sources prepared in the laboratory, contamination of the air in laboratory rooms and the radioactive content of the free air. The measurements of the radioactive content of the free air were made in different months during 1952-53. The locations used were the top of the College building and the local observatory at Colaba.

For interpreting the results of the free air experiments, a theoretical analysis of the radioactive contamination of the air has been carried out. The results show that

(1) the air blowing from the land has a random concentration of the order of 100 atoms per litre, with little or no thoron. This is fully accounted for by the normal uranium* content of the rocks and soils and it can be deduced with high probability that the land areas to the N and NE of Bombay contain no extensive uranium minerals near the surface; (2) when the winds are mostly from the S and SW, the air has thoron which is shown to be of recent origin. The thoron content of the winds from the sea comes from the local coastal sands and it is established that traces of thorium-bearing minerals are present in the sands along the coastline.

9. DR. N. K. SAHA (Delhi): *Fast Neutron-Reactions in Nuclei (Experimental)*

It is pointed out that the changing character of nuclear reactions with neutrons, as the energy of the neutrons is varied from a few eVolts to ≥ 50 MeV, and light to medium heavy and heavy nuclei are chosen, can be generally understood as a consequence of variation of level-width of nuclei in different regions of nuclear excitation and the Gamow penetration factor of Coulomb barrier. Factors like the shell structure of nuclei, high angular momenta of the particles etc., may influence the results only in special cases. In this context the study of 'threshold reactions' in intermediate nuclei fast neutrons (≤ 10 MeV) appears to be particularly promising. In suitably chosen target nuclei these reactions can be produced at an average constant neutron energy well within the sum of the reaction threshold and the height of the potential barrier. Any observed variation of the reaction cross-sections with mass number under these circumstances would then reflect the level-width variation of the nuclei. Results of such experiments performed on the measurement of relative cross-sections of (n, p) -reactions in S^{32} , P^{31} , Mg^{24} , Al^{27} and Fe^{56} using a Cd-filtered 100 mgm $Ra\alpha + Po$ -source are reported. Determination of absolute cross-section of (n, p) -reaction in S^{32} using the same source and a 'poor' spherical geometry is described. This involves electrical and chemical separation of radiophosphorous P^{32} (14.3 days) produced from the S^{32} -reaction and the determination of the absolute β -ray counting efficiency of the G.M. counter. The relative cross-sections obtained for the different cases are then converted to absolute values. The results so far obtained are discussed and appear to be encouraging in the light of the meagre existing data in the field.

10. DR. S. N. GHOSHAL and DR. A. N. SAXENA (Calcutta); *On Beta Energetics and Nuclear Shell Structure*

The existence of discontinuities in neutron and proton binding energies have been observed at magic neutron and proton numbers by various workers. This effect should be reflected in the β -disintegration energies of radioactive nuclei, since it depends on neutron and proton binding energies. The discontinuities should become more marked if the difference $\epsilon_{\beta}(A, Z)$ between the observed β -disintegration energies $Q_{\beta}(A, Z)$ and the corresponding values $E_{\beta}^0(A, Z)$ calculated from Fermi—Weizsäcker formula is plotted against N or Z . Discontinuities in $\epsilon_{\beta}(A, Z)$ have been observed at $N=50, 82, 126$ and $Z=50, 82$ by the present authors.

The discontinuities in the β -disintegration energies at shell crossings have been explained by Suess and Jensen, Coryell and others as being due to discontinuities in Z_A values involved in Fermi-Weizsäcker formula, as also in the pairing energy term

$(\pi - \nu)$. Coryell has estimated the discontinuities in these two terms at various shell crossings. In the present investigation, the presence of $(\pi - \nu)$ effect between even and odd Z nuclei (for odd A) have been demonstrated most remarkably by plotting the the observed β -disintegration energies of an isobaric sequence against Z for different values of A .

The average $(\pi - \nu)$ effect has been calculated by comparing the values of $\epsilon_\beta(A, Z)$ for three or more consecutive Z values for a given A (odd). When the observed β -energies of an isobaric sequence, corrected for the $(\pi - \nu)$ effect, are plotted against Z , straight lines are obtained whose slopes give the B_A values involved in the $F - W$ mass formula. These B_A values deviate considerably from the B_A values calculated from the Fermi parameters. It seems that either the B_A values should be modified in order to account for the observed β -energies; alternatively, if the B_A values given by Fermi parameters are not changed, then $(\pi - \nu)$ values for each individual member of an isobaric sequence has to be specified.

Section of Chemistry

X. MODERN TRENDS IN ANALYTICAL CHEMISTRY.

Chairman : PROF. S. M. MEHTA (Bombay).

GROUP I (CLASSICAL METHODS)

1. PROF. S. M. MEHTA and (MRS.) G. G. KAPADIA (Bombay) : *Separation of Alkaline Earths from one another.*

During the course of investigations on the decomposition of alkaline earth sulphates, the question of the estimation of alkaline earths, when present in a mixture appeared to be of importance and to merit a special study. According to Hillebrand and Lundell 'No really good methods for separating calcium, strontium and barium are known. They are all imperfect and give correct results only through compensating errors.' A search of literature revealed that the methods described are either elaborate or have limitations in their applicability or are subject to appreciable errors. A method for the qualitative analysis of the barium group of metals based on the difference in the solubilities of the sulphites of calcium and strontium in dilute acetic acid was described by Hinds (*J. Amer. Chem. Soc.*, 1911, 37, 510-14). He, however, did not make any further study nor did he conceive the idea that the sulphite method could be developed into an excellent quantitative method of separation. There appears to be no other reference bearing directly on this subject.

A method has been developed in which advantage is taken of the increased solubility difference of calcium sulphite from strontium sulphite or barium sulphite in an aqueous solution containing equal parts of sodium sulphite and bisulphite. Standard conditions have been established for the separation of alkaline earth sulphites from one another. The standardised method has been applied to mixtures containing chlorides or nitrates of alkaline earth metals and it is found that a quantitative separation of the three alkaline earths from one another is possible with an error less than one per cent.

A method has also been worked out in which calcium sulphate can be quantitatively separated from a mixture of alkaline earth sulphates by taking advantage of the fact that lead sulphate is relatively less soluble than calcium sulphate in the presence of potassium acetate. It is found that calcium sulphate may be dissolved and estimated with an error not exceeding half a per cent by choosing the proper molar ratio of calcium sulphate and lead nitrate.

The sulphite method has been extended to the separation of calcium from magnesium and it is found that this separation is also quantitative (*cf.* Carron, *Ann. Chim. anal.*, 1912, 17, 127-29).

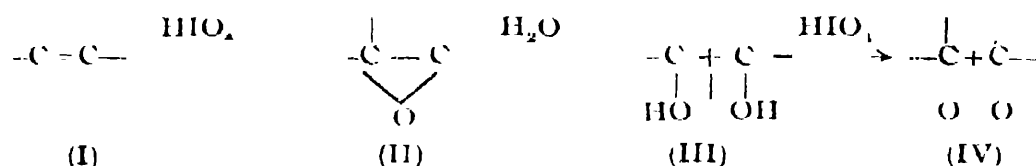
2. DR. ASIMA CHATTERJEE and DR. SUDHENDU GHOSH MAJUMDER (Calcutta) : *Periodic Acid—An Analytical Reagent for Exocyclic and Terminal Double Bonds.*

Malaprade reaction of periodic acid is well-known. It is used as a selective oxidising agent for various organic compounds containing hydroxyl groups or hydroxylamino groups attached to adjacent carbon atoms.

A new reaction of periodic acid has been studied by the present authors. It has been observed that periodic acid can be used as an analytical reagent for exocyclic and terminal olefinic groups in water-soluble organic compounds, carbon-carbon double bond undergoing facile cleavage (at 100°) and giving rise to carbonyl compounds. These carbonyl products can be readily characterised by their dimi-

thones or 2:4-dinitrophenylhydrazones. For establishing the general applicability of the reagent, periodic acid oxidation has been studied with compounds of known structure such as glycosine (Chatterjee and Ghosh Majumdar, *J. Amer. Chem. Soc.*, 1954, 76, 2459), quinine, quinidine, cinchonidine, cinnamic acid and corynanthine etc. It has been possible to establish that like ozone periodic acid can be used for detecting the presence and the exact site of unsaturation (either exocyclic or terminal olefinic groups) in organic molecules.

Plausible reaction mechanism of periodic acid is suggested as schematically drawn below :



The reaction proceeds excellently with water-soluble compounds. With water-insoluble substances several difficulties were encountered but these could be overcome by using suitable polar and nonpolar solvents. During the reaction iodine is found to be liberated which shows that periodic acid is reduced to iodine during the oxidation of double bonds.

3 DR. G. GOPALA RAO (Waltair) (In Absentia) *Sodium Vanadate as a new Oxidimetric Reagent.*

Numerous oxidants have been introduced from time to time as titrimetric reagents in Volumetric analysis, such as potassium permanganate, potassium dichromate, ceric sulphate and other ceric salts, potassium iodate, potassium periodate, potassium bromate, chloramine-T, etc. During recent years, Gopala Rao and coworkers have shown that sodium vanadate has special advantages over potassium permanganate, potassium dichromate and ceric sulphate as a volumetric reagent. It can be used for the estimation of ferrous salts in the presence of oxalic acid, citric acid, tartaric acid, alcohols and phenols, where potassium permanganate, potassium dichromate and even ceric sulphate give too high results. They have also employed sodium vanadate for the volumetric estimation of ferrocyanide alone and in the presence of hydrochloric acid, and oxalic acid; hydroquinone, in the presence of some phenolic compounds; and of uranous salts using diphenyl benzidine and other redox indicators. Sodium vanadate has also been used for the estimation of tartaric acid, and other organic compounds.

It is proposed to discuss in this paper recent developments in this field.

4 DR. G. GOPALA RAO (Waltair) (In Absentia) : *Cacotheline as a Reagent for the Detection of Ferric Iron.*

Cacotheline is a nitro derivative of brucine. This has been used extensively for the spot test detection of stannous tin. It is proposed to discuss in this paper, the recent work of Gopala Rao and coworkers on the use of Cacotheline as a reagent for the detection of ferric iron.

5 DR. I. K. TAIMNI (Allahabad) (In Absentia) : *Analysis of Metals by formation of Thiosalts and Precipitation of the Sulphides.*

Investigations carried out in this laboratory on the formation of thiosalts and the precipitation of sulphides by acidifying such solutions have yielded very interesting and useful results. These results have found application both in qualitative and quantitative analysis.

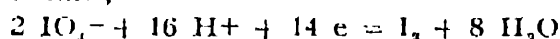
In the field of qualitative analysis, it has been shown that the formation of thiosalts can be utilized for the rapid and complete precipitation of metals like molybdenum, platinum and arsenic (arsenate) whose precipitation by hydrogen sulphide in acid solution is very tedious and takes considerable time. This discovery has been utilized in modifying the scheme of qualitative analysis for the basic radicals, the use of hydrogen sulphide being replaced by 1 N sodium sulphide reagent which easily forms thiosalts with the metals of the arsenic group.

The precipitation of sulphides by the decomposition of the corresponding thiosalts has also found wide application in gravimetric analysis. Many metals which are generally precipitated by hydrogen sulphide in acid solution for their gravimetric estimation, can be precipitated in a much shorter time by first forming and then decomposing the corresponding thiosalts. The precipitates of sulphides obtained in this manner, are easily filterable and can be weighed directly after washing with either ether and alcohol or water alone. The method has been shown to be applicable to arsenic, selenium, tellurium, molybdenum, tin, antimony, gold and platinum metals with the exception of osmium. Many metals which do not form thiosalts can also be precipitated and estimated as sulphides more satisfactorily by first precipitating them in alkaline solution and then acidifying the mixture before filtration.

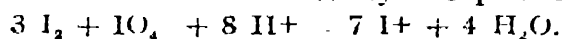
The results of these investigations have been published in a series of papers in *Analytical Chimica Acta* in 1953-1954.

6. DR. BALWANT SINGH (Hosharpur) (In Absentia) : *Volumetric Studies in Oxidation-Reduction Reactions : Oxidation with Potassium Meta-periodate Iodine Monochloride Method.*

Potassium metaperiodate in acid solution is a strong oxidising agent and is reduced to iodine,



The iodine is further oxidised by the periodate



The end of the titration is reached through this reaction whose completion is shown by the disappearance of the free iodine. Iodine cation forms a stable iodine monochloride, iodine cyanide and iodine bromide complex in the presence of a high concentration of hydrochloric acid, of hydrocyanic acid and of bromide ions respectively. Potassium Metaperiodate has been used as an oxidising agent in acid medium for the volumetric estimations of a large number of substances by the Iodine Monochloride, the Iodine Cyanide and the Iodine Bromide method.

The Iodine Monochloride method has also been developed in volumetric estimations, using Sodium Metavanadate, Chloramine -B and Chloramine--T as oxidising agents.

7. DR. R. C. MEHROTRA (Allahabad) (In Absentia) : *Application of Adsorption Indicators in Chemical Analysis.*

Since the discovery by Fajans in 1923, adsorption indicators have been extensively employed in chemical analysis. During the last ten years, a number of new adsorption indicators have been described by the author to be very useful in a number of titrations under special circumstances. For example, resorcinol quinolein (*Proc. Nat. Acad. Sci.*, 1946, 15, 148) can be used in the titration of halides in acidic solution whereas bromophenol blue (*Anal. Chim. Acta*, 1949, 3, 78) can be used for the above titrations both in acidic as well as ammoniacal solutions. Similarly tetra-iodo phenol sulphonphthalein has been found (*Zeit. Anal. Chem.*, 1950, 130, 390) to be a very useful indicator for the titration of mercurous ions.

In addition to the above, the author has described the applicability of a new class of adsorption indicators which have got both acidic as well as basic groups in their molecules and hence can be used in the titration of cations against anions as well as in the reverse titrations. Examples of indicators of this class are congo red (Anal. Chim. Acta, 1948, 2, 36) and phenyl- α -naphthylamine azobenzene p-sulphonic acid (J. Ind. Chem. Soc., 1949, 26, 511).

Moreover, the applicability of adsorption indicators has been extended to the estimation of thallium for the first time and it has been shown (Anal. Chim. Acta, 1949, 3, 73 and 78) that with the help of tetrabromophenol sulphonphthalein as adsorption indicator, thallous ions can be estimated either alone or in a mixture of silver and thallous ions.

Besides the practical applicability of the above indicators, the work has thrown fresh light on the mechanism of their colour change. Contrary to the conclusions of earlier workers, it has been shown that the adsorption indicators are held to the surface of the precipitates by forces of chemisorption and hence, the chemical structure of a particular indicator determines the conditions under which it can be employed.

8. SRI S. K. BOSTI, SRI U. K. BENEGAL, and DR. A. N. GHOSH (Calcutta) (In Absentia) : *Comprehensive Method of Analysis of Paint Pigment - Part I*
Rapid Method of Analysis of Zinc in Composite Paint Pigment

All standard methods of estimating zinc by ferrocyanide titration with an internal indicator stipulates isolation of zinc from interfering elements as sulphide. This involves the conventional group separation by sulphuretted hydrogen and in the case of pigments, - a class of material in which compounds of lead, lime, iron etc. very commonly occur with zinc oxide the volumetric titration does not offer any conspicuous advantage over the gravimetric method of estimating zinc.

Procedure has, however, been evolved which offers a very rapid means for estimating zinc oxide in pigments by the ferrocyanide titration. Zinc oxide of pigment is extracted with an ammoniacal solution of some ammonium salts effecting its simultaneous separation from extender as well as compounds of lead, lime, iron etc. The solution, after acidification with sulphuric acid, is boiled with either sulphurous acid or bromine water to adjust its oxidation-reduction potential which might be rendered high, or low with respect to diphenyl amine, due to contamination with chromate or any organic matter of pigment. It is then directly titrated with potassium ferrocyanide by the internal indicator method.

Estimations on a number of pigments of divergent nature show that the evolved procedure when compared with the orthodox volumetric or gravimetric methods, has the advantage of rapidity while making no compromise in respect of accuracy. It has also been found to serve as a quick and convenient means to estimate total and free zinc oxide in a mixture of zinc oxide and lithopone (coprecipitated barium sulphate and zinc sulphide), the total zinc being determined on an ignited sample.

GROUP II (INSTRUMENTAL)

9. DR. SANTI R. PALIT and SRI G. R. SOMAYAJULU (Calcutta) (In Absentia) :
Nonaqueous Titration - A New Development in Analytical Chemistry.

The subject of 'nonaqueous titration', i.e., titration conducted in water-free solvents, has gathered tremendous momentum in recent years. In contradistinction to the well-understood classical method of 'aqueous titration' for the estimation of strong and moderately strong acids and bases, the method of nonaqueous

titration admits analysis of weak acids and bases. The need for alternative media arises also from the fact that water is not an appropriate solvent for many compounds and, thanks to the brilliant conception of Lowry-Brönsted and Lewis, the behaviour of the latter in nonaqueous media has been made comprehensive, which has greatly contributed to our choice of proper solvents.

It follows as a direct consequence of the modern theory of acids and bases that a weak base would appear stronger in an acidic solvent and similarly a weak acid would appear stronger in a basic solvent. Taking this hint, Conant and Hall, the pioneer workers in this line, showed that weak bases could be titrated in acetic acid. Palit demonstrated the advantage in using glycol, a Lewis acid, in conjunction with a suitable cosolvent. These titrations are now being referred to as 'acetic' and 'glycolic' titrations. Moss, Elliott and Hall, on the other hand, conducted the most suggestive titrations of weak acids, e.g., phenols, in ethylenediamine, a basic solvent, analogous to the titration of weak bases in acidic solvents. Higuchi *et al.* studied the possibility of effecting titrations of such weak acids as alcohols, hydrocarbons, etc.

Thus a fresh and a promising field of research has been opened which has already scored striking triumphs in the realm of analytical chemistry.

10. SRI R. S. PHADKE, SRI R. S. SUBRAHMANYA and DR. M. R. A. RAO (Bangalore) : *Polarography in Non-aqueous Media : The Diffusion Currents of Nitrophenols in Ethanol-water Mixtures.*

The variation of the diffusion current of ortho-, meta- and para-nitrophenols, has been studied in aqueous solutions containing various proportions of ethanol, at four pH values. It is observed that the diffusion currents of the nitrophenols decrease as the % of the ethanol in the solution is increased. The diffusion currents are, however, proportional to the concentration of the nitrophenol in all the solutions studied. The nature of the wave is dependent on the % of ethanol in the solution at a given pH. The number of reduction steps given by a compound is not affected by the % of ethanol in the solution. The number of electrons involved in the reduction steps at different pH values has been discussed.

From the analytical point of view, absolute ethanol was the best solvent. A solution of ortho-Nitrophenol (0.5-4.0 millimoles per litre) could be estimated polarographically correct to $\pm 2\%$.

11. SRI S. K. DHAR (Poona) (In Absentia) : *Reduction of Tetravalent Germanium at the Dropping Mercury Electrode.*

The polarographic reduction of Ge^{+4} in the form of GeO_2 dissolved in distilled water has been studied in buffered and unbuffered media. Well-defined irreversible reduction waves were observed in both boric acid and bicarbonate buffers. In 0.25M boric acid adjusted to pH 7.8 with KOH, the $E_{1/2}$ at 30°C is -1.485 V (S.C.E.) and in 0.25M KHCO_3 adjusted to pH 7.4 with HCl the $E_{1/2}$ is -1.435 (S.C.E.). The $E_{1/2}$ shifts to less negative values by addition of electrolytes such as KCl or NaClO_4 . This effect is pronounced in boric acid at a lower pH range around 6.5. The shift is accompanied by increase in the wave height. The change of $E_{1/2}$ Vs pH in the pH range 6.5-9.0 is small. Experiments in boric acid media at higher pH values show a gradual shift of $E_{1/2}$ to more negative values and decrease in wave height, the effects being marked at pH values beyond 10.5. The Id/C values observed in 0.25M boric acid at pH 7.8 and 0.25M KHCO_3 at pH 7.4 are fairly constant up to $10^{-4} \times 8\text{M}/\text{l}$ without addition of gelatine or any other surface-active agent.

The reduction scheme may be represented by : $\text{HGeO}_3 + 4e + 2\text{H}_2\text{O} \rightleftharpoons \text{Ge}^0 + 5\text{OH}^-$, but it is assumed that the reducible species is a polygermanic acid, probably

$\text{H}_2\text{Ge}_3\text{O}_{11}$ which undergoes depolymerisation at higher pH values giving products which have more negative reduction potentials than that of the supporting electrolyte. Polarograms in KCl media, in absence of a buffer show a smaller limiting current and a more negative $E_{1/2}$. This observation is explained on the basis of the above-mentioned reduction mechanism, since the reduction in an unbuffered medium will lead to an increase of pH at the D.M.E.-solution interface, and the germanic acid diffusing into this region will behave similarly as in a medium of a high pH.

The standard potential data and the comparison of d.e.c. of Ge^{+4} in our study with that of Ge^{+2} as reported in literature, indicate 4e reduction. Further information might be obtainable from a detailed examination of the nature of the wave. The investigation is being continued to elucidate the above reported effects of electrolytes, the general nature of the wave, etc., whereby a clearer picture of the reduction process is hoped to be drawn.

12. SRI P. R. SUBBARAMAN (Poona) : *Electro-deposition of Complexed Germanium from Aqueous Solutions.*

Electrodeposition of germanium in thick layers from aqueous baths has not been successful, owing to the low over-voltage of hydrogen on germanium. Germanium can, however, be co-deposited with certain other metals, particularly with those which alloy with germanium easily. The deposition of the metal from its oxalate complex has been studied in view of the fact that such solutions are often obtained in the extraction of germanium from low-grade sources. It has been found that milligramme quantities of germanium, present as the oxalate, can be quantitatively co-deposited with copper on a platinum or copper cathode from a cyanide solution containing at least four times as much copper as there is germanium present. Co-deposition with copper is also possible from ammoniacal as well as from alkaline tartrate baths under controlled conditions. There is also evidence to indicate that co-deposition of germanium with silver can be effected from a cyanide solution.

Co-deposition of germanium with tin from an alkaline oxalate bath showed that the germanium deposit was limited to thin flashes of the metal.

13. DR. BH. S. V. RAGHAVA RAO (Waltair) : *Polarography of the Rare-Earths.*

Noddack and Brühl indicated from their studies that the rare-earths undergo a stepwise reduction $\text{M}^{+++} \rightarrow \text{M}^{++} \rightarrow \text{M}^0$ at the dropping mercury electrode. These could not be confirmed by later workers; e.g., Leach and Terrey with Scandium, Glockler *et al* in the case of Neodymium, Praseodymium and Gadolinium. Evidence is now adduced to show stepwise reduction in La, Pr, Nd, Sm (the last previously admitted) Gd, Dy and Yt. Sc stands apart confirming the findings of Leach and Terrey. The half wave potentials of the elements for the first wave are between -1.79 and -1.90 v vs S.C.E. and for the second between -1.94 to -2.94 to -2.03 v similarly. The limiting currents in the first wave show linearity with concentration, while in the second wave La, Nd and Pr yield linear relations. Other elements exhibit an anomalous behaviour. An attempt is made to explain this behaviour from disturbing electrode reactions. In all cases the hydrogen wave has been separated and the influence of pH on $E_{1/2}$ values and limiting currents is also presented.

14. DR. BH. S. V. RAGHAVA RAO (Waltair) : *Spectro Photometric Study of Metal Lattices and Chelate Complexes.*

From a study of the extinctions of metal oxinates, alizarin-sulphonates and other dyes, like haematin and haematoxyl, the possibility of their estimation is indicated.

Possible structures for the metal complexes are discussed, in particular the 4-5 oxinates of thorium and 2-3 oxinates of uranium in different solvents.

15. DR. G. V. L. N. MURTY (Jamshedpur) (In Absentia) : *Modern Trends in Steel Works Analysis with special reference to Spectrographic and Absorptiometric Methods.*

16. DR. BALWANT SINGH (Hoshuarpur) (In Absentia) : *Potentiometric Studies in Oxidation—Reduction Reactions : Oxidation with Chloramine-B.*

Chloramine-B has been used as an oxidising agent to determine indirectly potassium iodate, potassium metaperiodate, potassium bromate, potassium dichromate, hydrogen peroxide, chloramine-T and potassium permanganate by a potentiometric method. An excess of potassium iodide added to each of the substances in an acid medium was titrated back with a standard solution of chloramine-B, using platinum foil as an oxidation-reduction electrode coupled with a saturated calomel electrode through an agar-agar potassium chloride bridge.

It has been used as an oxidising agent for the potentiometric determination of potassium ferrocyanide, hydroquinone, hydrazine sulphate, potassium antimonyl tartrate, ferrous sulphate, quinhydrone, potassium iodide and arsenious oxide. In acid medium each substance was directly titrated potentiometrically with a standard solution of chloramine-B.

An attempt has been made for the potentiometric estimation of some aldehydes using chloramine-B as an oxidising agent.

17. SRI C. S. RAMANATHAN and SRI R. S. SUBRAHMANYA (Bangalore) (In Absentia) : *Effect of Solvent on the Diffusion Current of Ortho-iodobenzoic acid.*

The diffusion currents of ortho-iodobenzoic acid in different aqueous mixtures of ethanol, acetone, and dioxane have been determined, using lithium chloride as the supporting electrolyte. These determinations were made in solutions of different pH values. In all the solutions studied, it was noticed that the diffusion current decreased as the concentration of the organic solvent in the base electrolyte is increased. The wave forms were also affected by the solvent concentration. Good proportionality between the diffusion current and the concentration of the reducible substance was observed. The diffusion coefficients of ortho-iodobenzoic acid have been determined under polarographic conditions in all the solutions in which the diffusion currents were measured. For analytical purposes, a base electrolyte containing 50% dioxane (especially in the alkaline region) may be used with which an accuracy of $\pm 1.3\%$ could be obtained.

18. SRI B. R. LAKSHIMANA ROW and SRI C. C. PATEL (Bangalore) (In Absentia) : *Spectrophotometric Estimation of Thorium in Travancore Monazite.*

Further work on the estimation of thorium by the morellin method has indicated that the thorium content of the Travancore monazite can be estimated after removing the interfering radicals. The monazite is digested with concentrated sulphuric acid and the insoluble silica is filtered off. The slightly acidic filtrate is treated with oxalic acid to remove thorium and rare earths as oxalate precipitates. The oxalates thus obtained are ignited and the oxides are converted into nitrates. The solution of the nitrates in water is diluted with 60% alcohol. On mixing the alcoholic solution of morellin with the nitrate solution, an orange yellow complex, in the pH range 5 to 7, is obtained. The transmittance measurements on the complex are carried out at $\lambda = 515\mu$, employing Coleman Model 14 Universal Spectrophotometer. The thorium content in the solution could be computed from a

standard calibration curve for thorium-morellin complex. 0.4 to 50 p.p.m. of thorium in the solution can be estimated with an error of 3 to 5%.

19. SRI A. R. VASUDEVA MURTHY (Bangalore) (In Absentia) : *A Simple Thermo-gravimetric Balance.*

Continuous weighing in analytical chemistry has recently attracted the attention of many workers. The recent work of Duval and his associates has sometimes even challenged the reliability of well established data collected on the basis of traditional methods of gravimetric analysis. New compounds have also been discovered by this method and this has yielded several new methods of determinations. The assembly devised for such a purpose, automatically traces on a photographic paper a curve correlating the temperature or time with the gain or loss in weight of a material while being heated. This set up is, however, complicated and relatively expensive.

The present paper describes a very simple device which can be easily fabricated and is reasonably accurate. The apparatus consists essentially of a McBain-Baker Quartz fiber spring balance, the springs being wound by an automatic device and calibrated before use. The sensitiveness (stretch) of these springs ranges from 8 cm. to 10 cm. per gram weight. Hook's law is well followed in this range. The load that is ordinarily employed is about 0.3 g. By the use of a reference rod of quartz, the effective length of the spring to be measured by means of the travelling microscope (accuracy 0.001 cm.) is reduced to a minimum. Quartz or platinum buckets suspended by long rods are used to hold the substance under investigation.

The spring and the bucket are housed in a vertical silica tube supported by a suitable clamp and stand. The bucket portion is easily inserted in a tube furnace closed at one end. The furnace can be heated up to 1000°C., the rate of heating being regulated by means of a 'Variac'. Optimum rate of heating is found to be 3°-5°C. a minute. The temperature of the substance inside the furnace is read by a chromel-alumel thermocouple in a silica sheath hung close to the bucket.

The loss or gain in weight of the substance under investigation is followed by means of the travelling telemicroscope as already indicated. The results obtained are finally plotted having temperature (time) along the X-axis and the difference in weight along the Y-axis. The curves thus obtained are then interpreted and discussed.

20. DR. NARASIMHA SASTRI (Waltair) (In Absentia) : *Photochemical Methods in Chemical Analysis.*

Many catalysed reactions have been used as the bases of several volumetric and colorimetric determinations. Although light has been known to catalyse many chemical reactions, such photocatalysed reactions have not been used for long for analytical determinations. It is only within recent years that the photochemical action of light has been pressed into useful service in analytical chemistry. It is proposed to review this work in this paper.

GROUP III (MICRO, SEMI-MICRO, ULTRA-MICROANALYSIS ; SPOT ANALYSIS ; CHROMATOGRAPHY)

21. DR. ASIMA CHATTERJEE, (Miss) ANIMA CHOUDHURY AND SRI SUNIL-KUMAR TALAPATRA (Calcutta) : *Chromatographic Resolution of Natural Coumarins.*

Resolution of a mixture of coumarins, furocoumarins and chromenocoumarins, their derivatives and isomers has been possible by the application of paper chro-

matography technique (Riedl and Neugebauer, *Monatsch.*, 1952, 83, 1083). But very little studies have been made on the separation of their mixtures by column chromatography. Späth and Kainrath (*Ber.*, 1937, 70, 2272) first reported that limettin (5-7-dimethoxy coumarin) can be isolated from noncrystallisable Calabrian bergamot oil by its chromatography over Al_2O_3 using benzene and petroleum ether as the eluent. Later Caldwell and Jones (*J. Chem. Soc.*, 1945, 540) have shown that limettin, isopimpinellin and 5-methoxy-7-geranoxy-coumarin present in West Indian lime oil can be separated in pure state by their chromatography over "Birlec alumina". Schmid (*Helv. Chim. Acta*, 1947, 30, 1661) has purified the acetates of 4-methyl-5-hydroxy-7-methoxy-coumarin and of 4-methyl-7-hydroxy-5-methoxy-coumarin by chromatographing the mixture over alumina. These are the few informations which are available in the literature on column chromatographic separation of coumarins.

The present authors wish to report here about the studies on chromatographic resolution of several natural coumarins on Tswett columns. It has been possible to develop a suitable column chromatography technique for the separation of a mixture of coumarins, furocoumarins, chromeno-coumarins, their epoxides and other derivatives occurring in nature. This method has proved very successful in isolating natural coumarins which do not crystallise out from crude plant extracts and which are also susceptible to decomposition or isomerisation when tried to isolate by saponification following the method of Spath. The following mixtures of coumarins (50.0 mgs. of each) have been successfully resolved using Al_2O_3 in column No. 2 (17 cm x 30 cm) :

- (a) Coumarin and umbelliferone.
- (b) Coumarin and methyl umbelliferone.
- (c) Umbelliferone and methyl umbelliferone.
- (d) Coumarin, umbelliferone and methyl umbelliferone (used benzene as the eluent).
- (e) Coumarin, bergaptene and xanthyletin
- (f) Psoralene and bergaptene (used first benzene and then a mixture of benzene and ethyl acetate 97.5 : 2.5% as the eluent).

With the application of this technique it has been possible to isolate the coumarins, marmesin, marmum and umbelliferone from the crude extract of *Aegle marmelos* Correa as also the coumarins, furocoumarins and coumarin epoxides present in the seeds of *Heracleum nepalense*, using first benzene and then a mixture of benzene and ethylacetate in varying proportions. For quantitative separation of the coumarins rechromatography is necessary. It has been observed that benzene and a mixture of benzene and ethylacetate are excellent eluents for coumarin series. It has been further noticed that umbelliferone and phenolic coumarins are strongly absorbed in the column and can be very difficultly eluted out with boiling ethyl acetate or boiling chloroform. They (if fluorescent) can readily be detected on the column by ultraviolet light and in some cases by brushing it with ferric chloride. They are best eluted out of the column by extruding it, cutting out the zones where they are absorbed and by subsequent refluxing these zones with boiling methanol or ethyl acetate. Further improvements on this technique for its general applicability in the field of natural coumarins are in progress.

22. SRI M. L. SEN GUPTA (Calcutta) : *Chromatography of Fats and Oils.*

Chromatographic methods have been applied to fats and oils with three broad objects : (1) Separation of the unsaponifiable constituents which include the fat soluble vitamins, the steroids, phospholipids, and pigments; (2) Separation of the fatty acids or their esters to get individual components in a pure form, or to get qualitative and quantitative idea of the fatty acid composition, and lastly, (3) Concentration and isolation of autoxidised fractions of unsaturated fatty esters

to establish the mechanism of autoxidation itself. The adsorbents useful in this field comprise alumina, silicic acid and charcoal. Most of the unsaponifiables, the ethyl or methyl esters of the fatty acids, and the autoxidised unsaturated fatty esters have been separated on columns of alumina. Alumina however is a rather strong adsorbent for the fatty acids, the desorption or elution is difficult; in this case charcoal has proved useful. Clay-base adsorbents like fuller's earth, floridin, have been used on a minor scale in the separation of vitamin A from the unsaponifiables of fish liver oils.

As solvents, hydrocarbon solvents like petrol ether, benzene have been most useful for the unsaponifiables, fatty esters etc., during adsorption, the development and elution being achieved by incorporating small quantities of diethyl ether, chloroform, or benzene. Absolute alcohol and chloroform are used in the separation of fatty acids on columns of charcoal. In partition chromatography on silica gel with the lower members of the fatty acids, a mixture of furfuryl alcohol and pyridine has been used as the supported phase and hexane as the mobile phase.

As to techniques, elution development has been practised more than any other method. The techniques of frontal analysis, displacement development, or partition chromatography have been used mainly on fatty acids, although here also the elution technique has achieved some spectacular results. Partition chromatography on paper has not found much favour with fats and oils except in isolated cases, such as in the separation of the lower fatty acids, the different forms of tocopherol, and some steroids. Elution chromatography on the other hand has been applied in the separation of vitamins, pigments, the fatty esters, autoxidised products etc. Purest samples of the esters of long chain unsaturated acids like methyl oleate, linoleate, linolenate or arachidonate have been prepared by using long alumina columns with petrol ether, and petrol ether diethyl ether mixture as solvents by elution development.

23. Dr. S. K. DUTTA (Calcutta) : *Semi-micro Paper Chromatographic Analysis of Nucleotides and the Heterocyclic Nitrogenous Bases in Nucleic Acid.*

The nucleic acids, analysed, were isolated from calf thymus gland, herring roe, mouse sarcoma, yeast, *M. phlei*, and *Sarcina lutea*. The nucleic acids from mouse sarcoma, *M. phlei*, and *Sarcina lutea* were mixtures of both pentose-nucleic acid and desoxypentose nucleic acid and so they were first fractionated properly and then subjected to analysis.

Nucleotides were liberated from the nucleic acid by hydrolysis with sodium hydroxide, mild hydrochloric acid or sulfuric acid at suitable temperatures. The free purines and pyrimidines were liberated by hydrolysing the nucleic acid with formic acid, perchloric acid, and trifluoroacetic acid under suitable conditions. The merits and demerits of the different hydrolysing agents were studied.

In preference to other papers Whatman No. 1 filter paper was used for all these analyses. The solvents were acidic n-butanol with monomethyl ether of ethylene glycol, ammoniacal n-butanol with monomethyl ether of ethylene glycol, and 65% iso-propanol which was 2N with respect to HCl. Both ascending and descending one dimensional chromatograms were developed at room temperature in darkness.

After the development, the locations of the nucleotides and the heterocyclic nitrogenous bases were perfectly done with ultra-violet (253m μ) photography using suitable filters. Also they could be located and marked by using fluorescent screen on ultraviolet light.

The elution of the materials from the chromatograms was better done with 0.1N HCl solution at 37°C. Microanalysis of N and P and the complete ultra-violet absorption curves of the different eluates were recorded to characterise the substances. From absorption peaks at the proper wavelength of the eluates and

of standard nucleotides and purines and pyrimidines, the quantitative estimations were done in the chromatograms.

The method could estimate as little as 5 μ g. of the nitrogenous bases. Statistical calculation showed that the probable error of difference (R_{\pm}) were not significant.

24. SRI N. N. SHARMA and DR. R. C. MEHROTRA (Allahabad) (In Absentia) :
Semi-micro Applications of Cerate Oxidimetry.

The applications of ceric salts as volumetric reagent have been studied systematically by Willard and Young (1928-1936) and by Furman and collaborators. Willard and Young applied the reagent to the determination of a number of organic compounds by oxidation. They found that formic acid is not oxidised at all by ceric sulphate and many other organic acids, e.g., tartaric, malonic and malic acids are oxidised to a definite degree under controlled conditions. Empirical methods for the determination of a number of organic acids were described based on the above observation. However, it has been found by the authors that not only formic acid is quantitatively oxidised by ceric sulphate, but many other organic acids (tartaric, malonic, malic, glycollic, benzoic, phthalic, salicylic, fumaric, maleic and citric acids) are oxidised completely to carbon dioxide and water by ceric sulphate in the presence of a sufficient concentration of sulphuric acid. The oxidation of all these compounds being quantitative, it has been possible for the first time to employ the reagent on a semi-micro scale. It has also been possible by the new technique to analyse quantitatively mixtures of organic compounds—like oxalic and citric acids, formic and acetic acids and many others.

Further, ceric sulphate in the presence of a large concentration of sulphuric acid has been found a very valuable reagent for the volumetric determination of a number of organic reagents used as precipitants for metallic ions. It has been possible to estimate very small quantities of magnesium, aluminium, zinc, zirconium and thorium by this procedure, a special advantage of which is the comparative quickness with which the determination can be completed.

XI. TEXTILE CHEMISTRY.

Chairman : DR. B. K. VAIDYA (Ahmedabad).

1. PROF. G. M. NABAR (Bombay) (In Absentia) :

Textile Science is a comparatively modern subject and the phenomenal rise of the Textile Industry in the 19th century is not necessarily linked up with the development of science. It is most creditable that in spite of lack of knowledge of the fundamentals, the industry reached a high degree of practical perfection. One of the greatest obstacles to the intelligent understanding of textile processes was the lack of precise knowledge of the physical and chemical properties of the various textile fibres on which their behaviour depends. The technical practice is now slowly being translated into scientific processes and hence the subject of Textile Chemistry has assumed an enormous size. The real change in outlook took place after World War I. Today we see the complicated practical phenomenon, connected with the arts of dyeing, bleaching, finishing and printing, being explained on the basis of the fundamental sciences. These changes in the outlook have naturally resulted in highly specialized schools of thought in this field. Thus we read and hear about groups of men actively engaged in researches, restricting the scope of their investigation to a limited field such as chemistry of cellulose, theories of dyeing, etc., and meeting together to hold symposia to

discuss the results of their researches and also their difficulties. Such symposia are naturally restricted to a very narrow field of textile chemistry.

We in this country have not reached that degree of specialization mentioned above. The number of men engaged in any kind of investigation in the field of Textile Science is limited and at the moment it is difficult to hold such specialized symposia on topics in Textile Chemistry. It will therefore be understood why it has been decided to hold this symposium on Textile Chemistry. Those who visualise the enormity of the subject of Textile Chemistry will realise that it is a misnomer but no other more suitable name could be thought of, in the present circumstances. It is however earnestly hoped that in not too distant a future with the development of the various Textile Research Associations and University Departments in the country, it will be possible to hold specialized symposia in the field of Textile Science.

2. DR. V. B. CHIPALKATTI and DR. J. A. MASARGUPPI (Delhi) : *Some Theoretical Implications of the Viscosity of Cellulose Solutions.*

Einstein's fundamental equation correlating the specific viscosity with the concentration and density of a polymer in solution is discussed and it is shown that cellulose solutions do not obey the expected behaviour. A brief review is made of the various theories regarding the state of cellulose in solutions and it is suggested that there is still a divergence of opinion as to whether cellulose is molecularly or micellarly dispersed in solution.

The authors' work on the fluidity of cellulose in phosphoric acid is presented and an attempt is made to interpret the data in the light of the above background. The following points are noted :—

- (a) There is some difference in the manner in which the present authors¹ dissolve their cellulose and that of Ekenstamm,² Stamm & Cohen,³ Hiller & Pacsu⁴ and Jorgensen⁵ etc. The present authors dissolve their cellulose by macerating thoroughly in water so that viscosity readings can be taken from the first half hour. The latter take a time of one hour to 7 hours before viscosity readings are taken.
- (b) The rate curve for specific viscosity (η_{sp}) vs. time (t) obeys an empirical relation $\eta_{sp}=kt^n$, where k and n are constants.
- (c) The above relation holds good both in the very early stages of the degradation as well as in the later stages—even after 100 hours.
- (d) The rate curve has linear stepwise portions when $\log \eta_{sp}$ is plotted against $\log t$.
- (e) The exponential equation stated above applies equally well to the data of Hiller & Pacsu (*ibid*).

The significance of the above data is discussed and it is suggested that it is not correct to assume molecular dispersion of cellulose in solution. The solvent breaks up the hydrogen bonds between chains of cellulose molecules as well as the 1:4 glucosidic links. Neither all the hydrogen bonds nor all the glucosidic bonds are simultaneously available for the solvent-cellulose reaction. Their accessibility is limited and the course of the rate curve is indicative of the manner in which cellulose structure is continuously opened up during the degradation reaction. That the opening up process is similar both for the initial reaction when the D.P. is high and the final stages when the D.P. is low is significant and suggests that the micellar structure persists even after prolonged degradation of cellulose in phosphoric acid. It does not seem to be necessary to assume any special acid sensitive links such as the acetal links as suggested by Hiller & Pacsu nor to assume complete molecular dispersion in solution.

REFERENCES

1. Einstein, A.—Ann. Physic., 1906, **19** : 289.
2. Chipalkatti and Desai—Jour. Sci. Ind. Resch., 1953, **12B** : pp. 70-72.
3. A. Ekenstam—Ber. Deutsch., Chem. Ges., 1936, **69** : 540, 546.
4. Stamm and Cohen—Jour. Physical Chem., 1938, **42** : 921.
5. Hiller and Pacsu—Text. Resch. Journ., 1946, **16** : pp. 564-570.
6. Jorgensen—'Studies in the partial hydrolysis of Cellulose', Oslo, Trykt, Hos. Emil Moestue A/s. 1950.

3. DR. M. V. NIMKAR (Ahmedabad) : *On Theories of Moisture Absorption.*

Textile fibres when exposed to humid atmospheres absorb varying quantities of moisture. The amount of moisture absorbed depends on the structure of the fibres on the one hand and on the external conditions prevailing on the other. The absorbed moisture products profound changes in the physical and mechanical properties of fibres. These in turn affect the serviceability of the textile material. The diffusion of water vapour through the textile material determines the body comfort afforded by the material. This in turn is dependent upon the moisture absorbancy of the fibres. Thus the success of the manufacturing processes and the overall performance of the textile material depends largely upon its moisture relationships.

Based upon the study of these relationships, various theories of moisture absorption have been put forward from time to time. A broad survey of the literature reveals that these theories can be classified into three groups.

- (1) Capillary theories—i.e. theories based upon the capillary structure of the fibres.
- (2) Adsorption theories.
- (3) Solution theories.

In the present paper, these theories are discussed critically. Finally an attempt is made to co-ordinate all the three theories on the basis of a variety of data available on the moisture relationships of textile fibres.

4. DR. D. B. DAS (Calcutta) (In Absentia) : *Estimation of Pentosans in Cellulosic Materials.*

Cellulosic materials contains α -cellulose, pentosans, hexosans and polyuronides. The usual method of evaluating the pentosan content in these materials is to estimate first its total 'furfural' content,¹ carbondioxide value² and also the furfural content of the α -cellulose made³ from this particular source of cellulose. The furfural due to pentosans is then calculated from :—
'Furfural' due to pentosans \equiv Total "Furfural"—

'Furfural' due to polyuronides as determined from polyuronic CO ₂ and Norris & Resch. ⁴	'Furfural' due to α -cellulose prepared from the source.
--	--

The pentosans are then calculated from Kröbers table⁵ or according to Doree.⁶ In the above equation it is assumed that α -cellulose is free from pentosans or polyuronides and that all the furfural coming from α -cellulose is derived from the polymer whose building units are glucose only. From paper chromatographic analysis carried out in this Laboratory it has been shown^{6, 7, 8} however that jute α -cellulose prepared by the conventional method contains about 3% furfural and is invariably associated with pentoses such as xylose and arabinose. This was later on supported by Adams & Bishop,⁹ by a different method who have also shown

that α -cellulose prepared from other sources of cellulosic materials studied except cotton invariably contained pentoses. Recently Das, Mitra & Wareham¹⁰ by means of formic acid method of hydrolysis¹¹ developed in this Laboratory have shown chromatographically that even cotton α -cellulose contains pentoses (xylose and arabinose) which has been also confirmed by Adams.¹² These observations have not only an important bearing on the so far accepted structure of cellulose but also has resulted a serious problem in the estimation of pentose in the cellulosic materials

The furfural content of glucose is reported¹³ to be 0.62% and considering the observation of Das, Mitra & Wareham¹¹ that if jute α -cellulose (about 3% furfural) is treated with 10.5% NaOH alternatively for 8 times, the furfural value of the product although drops to 0.75%, the product still contains readily detectable pentoses, it is suggested here that if the furfural due to pentoses present in cellulosic materials is calculated from the following equation much nearer to the true value than that have hitherto been possible can be obtained.

'Furfural' due to pentosans \equiv Total "Furfural" - 'Furfural' due to 0.62
polyuronides as
determined from
polyuronic CO₂
and Norris &
Resch.⁴

REFERENCES

1. Doree Method of Cellulose Chemistry, 1933, p. 361, 363, Chapman and Hall, London.
 2. *Idem—Ibid*, p. 372.
 3. Ritter—Ind. Eng. Chem. Anal. Edn., 1929, **1** : 52.
 4. Norris and Resch—Biochem. J., 1935, **29** : 1594.
 5. Doree—Method of Cellulose Chemistry, 1933, p. 362, 363, Chapman and Hall, London.
 6. Das, Mitra and Wareham—Science and Culture, 1952, **18** : 249.
 7. Das—Textile Manufacture, 1953, August issue.
 8. Das, Mitra and Wareham—Nature, 1953, **171** : 613.
 9. Adams and Bishop—Nature, 1953, **172** : 28.
 10. Das, Mitra and Wareham, in course of publication.
 11. Das, Chaudhuri and Wareham—Science and Culture, 1952, **18** : 197.
 12. Adams—National Research Council of Canada, Private Communications, June, 1954.
 13. Sarkar, Mazumdar and Pal—J. Textile Institute, 1948, T44.
 14. Das, Mitra and Wareham—Nature, in the press.
5. DR. E. H. DARUWALLA (Bombay) : *Studies in the Transfer of Dyes from Thickener to Fibre Substance during Steaming.*

Although the operation of printing of textile materials has been carried out to a very large extent, because of the complexity of the process the fundamentals underlying the various steps involved in printing are but little studied.

An attempt has been made to simplify the normal printing process so that the characteristics of the transfer of dye from the applied printing paste to the fibre substance may be studied quantitatively and systematically under standard conditions. Employing this simplified technique the transfer behaviour of selected direct cotton and acid dyes has been studied in detail. The type of thickener used and the presence of electrolytes and hygroscopic agents in the printing paste have been found to influence the rate of dye transfer and the proportion of the

dye transferred at equilibrium to a considerable extent. The results are explained on the basis of the magnitude of the "negative potential barrier" at the cellulose-thickener interphase and also in terms of the distribution of water between these two phases.

The study has also been extended to another fibre substance such as cellulose acetate, and the characteristics of the dye transfer of selected disperse and soluble acetate rayon dyes have been investigated. The effect of chemical structure and particle size of the dye and the presence of electrolytes and swelling agents for the fibre substance has been examined for appropriate conditions of application. In general there is a close resemblance between the dyeing behaviour of each class of dye and the corresponding transfer behaviour during steaming.

6. DR. B. K. VAIDYA (Ahmedabad) : *Photodecomposition of some Basic and Azo Dyes.*

Several types of reactions were noticed to occur when dyes of the triphenylmethane class in form of purified oxalates were exposed to sunlight or to the light of carbon or mercury vapour arcs. In powder form, after a few weeks to a few months exposure in sunlight leuco form of the dyes could be identified and isolated. Dealkylation also occurred in dyes having the p. amino hydrogens substituted by alkyl groups. In solutions, the oxidation process was favoured and Michler's types of ketones were formed. The tendency for the latter type of reaction was however restricted to polar molecules like Malachite Green, the symmetrical non-polar molecules like Crystal Violet and Rosaniline showing practically no ketone formation. The quantum efficiency of the photoprocess in solution in presence of air was found to be extremely low being of the order of one molecule for a million quanta of the absorbed radiations.

The direct dyes of the azoic class were generally observed to undergo an oxidation process in light which resembles their thermal oxidation in presence of an oxidising agent. Existence of intermediate oxidation compounds have been postulated but they have so far not been isolated. Spectrophotometric and tintometric studies on dyed cotton samples accompanied by parallel chemical estimations however indicate that the preliminary loss of colour occurs before the rupture of the azo linkage takes place, an indirect evidence being obtained thereby of the presence of intermediate colourless products probably of the peroxide or the azoxy types.

Either class of dyes as well as those of the nitrogroup may have their oxidation process markedly retarded in solution or on fabric in the presence of copper sulphate, the retardation factor relative to the reaction without copper sulphate ranging from 1.2 to 1.5 for many azo dyes with the exception of the colours of the chlorazol sky blue type having—OH groups in favourable positions in the molecule for the formation of a copper complex. In such cases the retardation factor may go up to 7. In the triphenylmethane class of dyestuffs the retardation to the extent of 1.5 to 2.5 times was common while for some nitro dyes, copper sulphate did not affect the rate of change but considerably advanced the insolation period.

7. DR. A. B. SEN GUPTA (Calcutta) : *Some Characteristic Chemical Properties of Jute in Relation to Bast Fibres of the Hibiscus Group.*

A number of bast fibres closely allied to jute can be successfully processed on jute mill machinery and the most common of these substitute fibres are derived from the Hibiscus plant, usually from the species known as *H. cannabinus*. The fibres from *H. cannabinus* are described by a variety of different names but, in India, are usually known as either Mesta or Bimli and in other countries as Kenar. The quality of Hibiscus fibres from a spinning point of view varies similar

to that of jute but, generally speaking, this fibre is coarser and more brittle than jute and, as a result, is not suitable for the spinning of fine yarns. There is however, very little difference in the chemical composition of jute and the Hibiscus fibres so far as the major constituents other than lignin are concerned.

In the work described, a particular study has been made of the relative proportions and mode of occurrence of the characteristic groups namely, acetyl, carboxyl and methoxyl, which are generally regarded as of minor importance, with a view to obtaining some additional evidence for differentiating jute from the Hibiscus fibres. In addition, the lignin contents of these fibres have been re-examined with a more accurate procedure recently made available in order to ascertain whether the reported difference in lignin contents was really significant.

From an analysis of the several varieties of each of the fibres examined it has been found that the difference in lignin and holocellulose contents of jute and other substitute fibres are significant. Both the acetyl content and the total acidity, i.e., the combined acidity due to acetic acid and uronic acid of the substitute fibres, are appreciably higher than the corresponding values obtained from jute. No definite conclusion could be drawn from the variation in the carboxyl contents occurring in different forms. It was however found that the amount of methoxyl associated with the lignin fraction is relatively high and that associated with the carbohydrate is low in jute when compared with other Hibiscus fibres. It seems possible therefore that, from the variations in the values mentioned above, jute can be differentiated from other fibres in the Hibiscus group.

8. DR. I. B. CHAKRAVERTI (Calcutta) : *Preferential Adsorption in Jute with Particular Reference to Chemical Finishing Operation.*

Jute has been observed to possess selective affinity for many organic proofing and finishing materials as a result of which these compounds are preferentially adsorbed by the fibre from their aqueous solutions. The importance of such absorption in relation to wet processing technology when applied to jute has been discussed. Quantitative measurement of sorption characteristics was attempted with a mildew-proofing agent, salicylanilide, and this first necessitated the development of a reliable method of estimation of salicylanilide in jute based on the indophenol reaction of phenols with p-phenylene diamine as proposed by Fancutt and Twiselton.

The preferential adsorption of the compound has been shown to originate from the potential functional carboxyl and phenolic hydroxyl group of the polyuronide and lignin fractions of jute. Progressive removal of these functional groups leads to a reduction of the tendency. When both lignin and polyuronides are eliminated the resulting alpha-cellulose of jute exhibits preferential adsorption only to a slightly greater extent than cotton cellulose which does not show this tendency towards the mildew-proofing agent. The phenolic hydroxyl groups seem to be mainly responsible for the adsorption because wool and silk which do not contain either hemi-cellulose or lignin but possess phenolic hydroxyl group (e.g. from tyrosine) exhibit this tendency to a marked degree, although some absorption might be due to the free carboxyl group of the amino acids.

Other lignocellulosic fibres examined such as flax, sisal, sunn hemp, urena lobata also exhibit selective affinity for salicylanilide in various degrees. No linear correlation could however be observed between the lignin content and the degree of preferential adsorption of the various lignocellulosic fibres examined.

Preferential adsorption of two insecticidal compounds, DDT and pyrethrins synergised with piperonyl butoxide, has also been observed. Possible mechanism of the preferential adsorption has been discussed. A number of remedies have been suggested to reduce the unevenness of deposition of the proofing compound on the fibre arising out of such adsorption.

9. SRI M. L. SEN GUPTA (Calcutta) : *Sulphated Fatty Alcohols as Textile Auxiliary Agents.*

The use of sulphated fatty alcohols of the Gardinol Type as textile assistants covers a wide field; the properties responsible for this are their stability to hard waters, alkali and dilute acids. The lower alcohols are usually favoured as wetting agents and the higher ones as detergents.

For their industrial preparation, the alcohols are to be procured at an economic rate. They are usually obtained from certain natural waxes as spermaceti or by the hydrogenation of fatty acids or esters.

The technique of their production is dependent on the mode of sulphation. This varies with the nature of sulphating agent which may be concentrated sulphuric acid, oleum or chlorosulphonic acid. The sulphonated product is to be carefully neutralised and suitably adjusted to contain adequate amounts of inorganic salts.

In this paper the above conditions have been studied and discussed.

10. DR. T. RADIAKRISHNAN and DR. P. C. MEHTA (Ahmedabad) : *Laboratory Tests of Weavability.*

The possibility of using laboratory evaluations of sized yarns in predicting their weavability is of both practical importance and theoretical interest. Recent work has shown that the conventional measurements of single-thread tensile strength and elongation at break have little correlation with the rate of warp breakages in weaving. An examination of the nature of stresses imposed on the yarn during weaving shows that this is not a surprising result. The yarn is seldom subjected to a load or a stretch anywhere near the rupture value. Instead, it is subjected, at a high frequency, to a repeated cycle stress and relaxation, the stress usually not exceeding a fraction of the breaking strength or elongation. Superimposed on this is the abrasion of the sized warp against the healds and reeds and against its neighbouring yarns. It is expected that cyclic loading tests to get the elastic performance characteristics of sized yarn together with tests for its abrasion resistance should give us a better understanding of its weavability. An attempt is made in this paper to correlate laboratory data on the elastic performance and abrasion resistance of yarns sized in different ways with corresponding data of warp breakages obtained from large scale working of these yarns.

11. SRI J. B. SANE (Bombay) (In Absentia) : *Role of a Textile Chemist in the Industry.*

The cotton Textile Industry is the premier Industry of India. The wet processing of the cotton textiles is a necessary addition to the production of cotton fabrics. Among the various products used in this industry are :

- (1) Cellulose in the form of raw cotton, yarn and woven cloth.
- (2) a number of chemicals such as enzymes, starches, softeners, mineral acids and alkalis, bleaching agents such as chlorine and hydrogen peroxide, organic chemicals such as dyestuffs and various auxiliary products of a like nature.
- (3) a number of machines required in the processing Industry—wherein a variety of materials of construction is used.

It is necessary for a chemist to know the methods of testing the purity of all the above and judge for himself the nature, the extent of the impurities to be tolerated and these to be avoided. Regarding the materials of construction we should know the suitability of certain materials for a particular process in view.

Another very essential chemical is water; and the chemist must know the properties of water that is available and must know the impurities, which can be

tolerated and those that cannot be and should know the methods to render the water harmless for a particular process.

A textile chemist has to be his own engineer as far as his machines are concerned. He must know the various parts and their maintenance. He must know the speed and performance of his machines.

A textile chemist has to know the sequence of the processes and the methods adopted to achieve uniformity. In the mass production a yard of cloth processed one day must be as good as the cloth processed previously and as good as the one to be processed next day. He has also to establish controls at every stage to achieve this uniformity. He has to set up certain standards of some measurable quantities such as tensile strength, whiteness of bleached goods, absorbancy of goods to be subsequently dyed or printed; fastness of dyed and printed materials and the final finish and handle required. He must also know the methods of final get up and packing so as to attract the attention of the public.

Then comes the final examination and check up of the finished fabrics and ascertain the tolerances as established by methods of quality control.

In carrying out all the above, a textile chemist as a man must be cost-conscious. He has now to satisfy the economic standards. He has to establish optimum conditions in the production so that his cost is low and the quality as good. Thus he has to establish a check on his labour, stores and overhead.

He is concerned with getting more from his machines, with minimum labour and with minimum consumption of stores. He has to maintain comparatively small indirect labour and minimum steam and water.

As far as he is connected with running his department, he must know the factory laws and laws affecting the labour. He has also to know how to get along with his colleagues. Lastly he must be upto date with the latest development in the line and must know how to impress his superiors by good expression and pleasant manners.

It is very difficult to get such a textile chemist possessing all these attributes. Only years of experience can equip a chemist as above. But it is quite possible to train a budding textile chemist so that he realizes what is required of him when he enters the industry. Our young men to-day know much about the theoretical side of our subject but lack greatly the other practical aspects of the line. In order to prepare him for such a job, more stress must be given to the practical training period when the whole programme of training must be developed and carefully watched by the professors along with the Managers of the factories, and unless that is done, the industry will continue to pay during the initial periods of the employment.

12. In the discussion that followed, Dr. K. S. G. Doss (Kanpur), Dr. A. M. Trivedi (Ahmedabad) and Dr. D. C. Tapadar (Hazinagar, W. Bengal) also participated.

XII. SYNTHESIS OF STEROIDS.

Chairman : DR. D. K. BANERJEE (Bangalore).

1. DR. D. K. BANERJEE (Bangalore) : *Stereospecific Syntheses of trans-(β)-Hydroxy-8-Methyl-4,5-(4'-Methoxycyclo)-Hydrindane and d, 1-Equilenin Methyl Ether.*

6-Methoxy- α -tetralone (I) on formylation with ethyl formate in the presence of dry sodium ethoxide in benzene gave a solid 2-hydroxy-methylene-6-methoxy- α -tetralone (II), m.p. 67-68°, in 99% yield. A solution of the hydroxymethylene derivative in glacial acetic acid on treatment with hydroxylamine hydrochloride

yielded the isoxazole (III), m.p. 57°. The latter on treatment with sodium ethoxide could be converted into the β -keto nitrile (IV), m.p. 96-98°, which was methylated by refluxing with potassium *t*-butoxide and methyl iodide to give 2-methyl-2-cyano-6-methoxy- α -tetralone (V), m.p. 70°. The overall yield in these steps was 83%. The Stobbe condensation of V with dimethyl succinate furnished methyl 1-keto-8-methyl-4, 5-(4'-methoxybenzo)-hydrindene-3-carboxylate (VI), m.p. 114-115°, in 42% yield; U.V., λ_{\max} 303 m μ ($\log \epsilon$ 4.2); I.R. 5.67 μ , 5.8 μ . The unsaturated keto ester (VI) was hydrolysed by refluxing with a mixture of barium hydroxide in alcohol and water under nitrogen and the crude acid thus obtained was evaporatively distilled under vacuum in an atmosphere of nitrogen, expecting that the decarboxylation would occur during distillation. However, an acid was obtained as a light pink solid, m.p. 109°. The structure (VII) has been assigned to it on the basis of U.V. data— λ_{\max} 254 m μ ($\log \epsilon$ 4.01). The crude acid was decarboxylated by refluxing with a mixture of pyridine hydrochloride and hydrochloric acid to give a neutral oil in 75% yield. The oil was chromatographed on an acid washed alumina column using *n*-hexane-benzene (1:3) and benzene as eluting solvents. The light yellow solid, m.p. 129-130°, λ_{\max} 264.5 m μ ($\log \epsilon$ 4.2), eluted by *n*-hexane-benzene, was obviously the β , γ -unsaturated ketone (VIII), and the low melting fraction, m.p. 60-62°, λ_{\max} 227 m μ ($\log \epsilon$ 4.2), λ_{\max} 279 m μ ($\log \epsilon$ 3.5), eluted by benzene, was the α , β -unsaturated ketone (IX). The α , β -unsaturated ketone, m.p. 60-62°, was catalytically hydrogenated in alcoholic solution over 10% palladium charcoal to furnish an oil, λ_{\max} 279 m μ ($\log \epsilon$ 3.6). The oil, which could not be induced to crystallise, was demethylated by boiling with mixture of 48% hydrobromic acid and acetic acid under nitrogen. On purification by evaporative distillation the phenolic ketone (XI) was obtained as a colourless crystalline solid, m.p. 155-156°. This melting point agrees with the α -isomer obtained by Bachmann and Thomas [J. Am. Chem. Soc., 64, 94 (1942)] following a different route. The α , β -unsaturated ketone (IX) is obviously formed from the unsaturated keto ester (VI) by the shifting of the ethylenic linkage from $\Delta^{1,2}$ to $\Delta^{2,3}$ position during the saponification of VI or decarboxylation of the acid obtained thereof. The new asymmetric centre formed at C₉ as a result of this migration of the double bond should assume the more stable *cis* configuration, so that the α -isomer of Bachmann and Thomas must have *cis* configuration. Catalytic hydrogenation of VIII yielded an oil, from which no crystalline product could be obtained even after chromatography on an alumina column, and most probably consists of a mixture of the *cis* and *trans* isomers of the reduced ketone (X and XII). This, however, could be expected in view of Johnson, Petersen, and Gutsche's experience in the synthesis of equilenin [J. Am. Chem. Soc., 69, 2942 (1947)].

With a view to achieving the stereospecific synthesis of the *trans*-hydrindane ring system, the unsaturated keto ester (VI), which has the double bond fixed at $\Delta^{1,2}$ position, was chosen as the suitable starting material. It was further considered that the formation of some *cis* isomer during the reduction of the β , γ -unsaturated ketone (VIII) might have been due to the presence of the ketone group. In order to eliminate the influence of the keto group, VI was reduced with sodium borohydride to give the hydroxy unsaturated ester (XIII), m.p. 117-118°; U.V., λ_{\max} 302 m μ ($\log \epsilon$ 4.1); I.R., 2.81 μ , 5.82 μ , in 99% yield. The latter was saponified with barium hydroxide to furnish the corresponding acid (XIV), m.p. 215-216°(d.), in 90% yield, which was decarboxylated by heating under nitrogen at 220-230°. The neutral unsaturated alcohol (XV), m.p. 149-150°, λ_{\max} 266 m μ ($\log \epsilon$ 4.1); thus obtained (74%), was catalytically reduced to yield *trans*-1(β)-hydroxy-8-methyl-4, 5-(4'-methoxybenzo)-hydrindane (XVI), m.p. 75°, λ_{\max} 280 m μ ($\log \epsilon$ 3.5). The unsaturated alcohol (XV) could also be obtained by the reduction of the β , γ -unsaturated ketone (VIII) with sodium borohydride. The β -configuration (steroid nomenclature) of the hydroxyl at C₁ has been assigned on the basis of the observation that the 17-keto steroids are invariably reduced by lithium

aluminum hydride to 17-hydroxy steroids with β -orientation [Pieser, *Experientia*, 6, 312 (1950)]. Finally XVI was oxidised with pyridine-chromic acid complex to furnish the crystalline ketone (XII), m.p. 112-113°, in 37% yield. The latter was demethylated with hydrobromic-acetic acid mixture to yield the phenolic ketone (XVII), m.p. 208-210°. These melting points are in close agreement with those described by Bachmann and Thomas for the β -isomer, which should, on the basis of this work, be considered as the *trans* isomer.

Several methods for the synthesis of equilenin (XXIII, R=H) have been described by different workers [Bachmann *et al.*, *J. Am. Chem. Soc.*, 62, 824 (1940); 73, 3660 (1951); Johnson *et al.*, *ibid.*, 69, 2942 (1947); 72, 505 (1950)], but none of these is stereospecific. By the application of the aforementioned procedure for the synthesis of the benzohydrindane derivative a stereospecific synthesis of d, 1-equilenin methyl ether has been realised. The tetracyclic unsaturated keto ester (XVIII), previously prepared by Johnson, Petersen, and Gutsche (*loc. cit.*), was reduced with sodium borohydride to give methyl 3-methoxy-17 (8)-hydroxy-14, 15-dehydroequilenane-15-carboxylate (XIX), m.p. 178° λ_{max} 230 m μ (log ϵ 4.45), λ_{max} 265 m μ (log ϵ 4.3), μ_{max} 320 m μ (log ϵ 4.2) in 92% yield. The unsaturated hydroxy ester (XIX) was saponified with barium hydroxide and the corresponding acid (XX), 270-273° (d.) was obtained in 87% yield. The decarboxylation of the acid was carried out in small quantities by heating it mixed with glass powder for a short time at 300-310° under nitrogen. 3-Methoxy-17 (β)-hydroxy-14, 15-dehydroequilenane (XXI), m.p. 187-190°, λ_{max} 235 m μ (log ϵ 4.45), λ_{max} 255 m μ (log ϵ 4.42), λ_{max} 263 m μ (log ϵ 4.05), λ_{max} 303 m μ (log ϵ 4.43), λ_{max} 291 m μ (log ϵ 4.01) λ_{max} 332 m μ (log ϵ 3.18), λ_{max} 347 m μ (log ϵ 3.0), was obtained in 67-83% yield. The catalytic reduction of XXI yielded the saturated alcohol (XXII), m.p. 180°, λ_{max} 228 m μ (log ϵ 4.7), λ_{max} 278 m μ (log ϵ 3.66), λ_{max} 324 m μ (log ϵ 3.29), λ_{max} 339 m μ (log ϵ 3.36). Oxidation of XXII in the cold with sodium dichromate dihydrate and acetic acid in benzene-acetic acid solution furnished d, 1-equilenin methyl ether (XXIII, R=CH₃) in 71% yield. The melting point of d, 1-equilenin methyl ether, thus obtained, was not depressed by admixture with an authentic specimen.

Since strong evidence in favour of the *trans* configuration of the hydrindane moiety in equilenin has accumulated due to the work of Klyne [Nature, 161, 434 (1948)] on molecular rotation differences and Bachmann *et al.* [*J. Am. Chem. Soc.*, 72, 1323 (1950), 72, 2527 (1950)] on epimerisation studies of some steroids and related compounds, and the lactams corresponding to desoxy equilenin and desoxy isoequilenin, this new stereospecific sequence of reactions for the formation of *trans*-hydrindane systems receives further confirmation.

2. DR. P. C. DUTTA (Calcutta) : *On 11-Oxygenated Steroids.*
3. DR. G. SINGH (New Delhi) : *Stereochemistry of Steroids.*
4. DR. S. M. MUKHERJI (Hoshiarpur) (In Absentia) : *19-Nor-Steroids.*
5. DR. M. S. NEWMAN (Ohio State Univ., U.S.A.) and

DR. S. SWAMINATHAN (Madras) : *Synthesis of 1-Acetyl-6-oxo-8 α -methyl-3, 4, 6, 7, 8, 8 α -hexahydronaphthalene.*

The alkylation of 2-Methyl-1, 3-cyclohexanedione (I) with 1-diethylamino-3-butanone (II) in the presence of equimolar amount of Pyridine gave 70-75% yield of 1, 6-di-oxo-8 α -methyl-1, 2, 3, 4, 6, 7, 8 α -Octahydronaphthalene (III) (m.p. 47-5-48.5, $\lambda_{\text{max}}^{\text{EtOH}}$ 243 m μ ; log₁₀ ϵ 4.18; Dioxime m.p. 199-201°; mono-2, 4 DNP m.p. 186-187°; Di-2, DNP m.p.; 257-60°3. The conventional method of alkylation of I with the methiodide of II in the presence of sodium methoxide yielded little, if

any, of III the major product being 2-(2'-carboxyethyl-3, 6-dimethylcyclohex-2-eneone (m.p. 47.5-48°; $\lambda \frac{E_{\text{toH}}}{\text{max}}$ 242 m μ ; $\log_{10} \epsilon$ 4.25; 2, 4-DNP m.p. 103-104°; Semi-carbazone m.p. 195-196°). The bicyclic diketone III was unstable to aqueous alkali, being converted almost quantitatively into 3-(3'-carboxypropyl)-4-methyl-cyclohex-2-eneone (IV m.p. 78°; $\lambda \frac{E_{\text{toH}}}{\text{max}}$ 238 m μ ; $\log_{10} \epsilon$ 4.17).

Compound III when reacted with triethyl-orthoformate furnished 1-oxo-6-ethoxy-8a-methyl-1, 2, 3, 7, 8, 8a-hexahydronaphthalene (V; b.p. 101°/1 mm.; $\lambda \frac{E_{\text{toH}}}{\text{max}}$ 243 m μ ; $\log_{10} \epsilon$ 4.17; oxime m.p. 132.5-134°) in 85% yield. The enoether V when treated with hydrogen cyanide in the presence of triethylamine gave (50-55%) a mixture of the epimeric cyanohydrins (m.p. 152-156°, $\lambda \frac{E_{\text{toH}}}{\text{max}}$ 242 m μ ; $\log_{10} \epsilon$ 4.3). The latter when dehydrated with a mixture of pyridine and phosphorus oxychloride gave a 60% yield of 1-cyano-6-ethoxy-8a-methyl-3, 7, 8, 8a-tetrahydronaphthalene (VI; b.p. 125-128°/2 mm.; $\lambda \frac{E_{\text{toH}}}{\text{max}}$ 232 m μ ; $\log_{10} \epsilon$ 4.08). This unsaturated nitrile proved unreactive towards methylmagnesium bromide. Compound III when reacted with hydrogen cyanide was converted quantitatively into an epimeric mixture of 1-cyano-1-hydroxy-6-oxo-8a-methyl-1, 2, 3, 4, 6, 7, 8, 8a-octahydronaphthalene (VII, m.p. 112-116°, $\lambda \frac{E_{\text{toH}}}{\text{max}}$ 244 m μ ; $\log_{10} \epsilon$ 4.14). Attempts to dehydrate VII to the corresponding unsaturated nitrile failed.

Compound V reacted with acetylene in the presence of potassium tertiary amyloxide to give, besides IV, a 30-35% yield of a mixture of epimers of 1-ethynyl-1-hydroxy-6-oxo-8a-methyl-1, 2, 3, 4, 6, 7, 8, 8a-octahydronaphthalene (VIII; α -ethynyl epimer m.p. 171.5-172.5°; $\lambda \frac{E_{\text{toH}}}{\text{max}}$ 240 m μ ; $\log_{10} \epsilon$ 4.13; C=O absorption at 6.6 μ ; C=C at 4.8 μ ; ν -OH at 3 μ ; beta-ethynylepimer m.p. 145.5-147°; $\lambda \frac{E_{\text{toH}}}{\text{max}}$ 240 m μ ; $\log_{10} \epsilon$ 4.16). The ethynyl carbinol VIII α when refluxed with 85% formic acid gave, besides VIII β , a poor yield of 1-acetyl-6-oxo-8a-methyl-3, 4, 6, 7, 8, 8a-octahydronaphthalene (IX) isolated as the dioxime (m.p. 200-202°). It was subsequently found that the reaction mixture obtained by reacting III with sodium acetylide in liquid ammonia followed by acidification contained considerable amounts of IX which could be isolated as the dioxime. This dioxime when decomposed with pyruvic acid gave IX (b.p. 85-88°/0.02 mm. $\lambda \frac{E_{\text{toH}}}{\text{max}}$ 246 m μ ; $\log_{10} \epsilon$ 4.28; Two C=O absorption peaks at 5.85 μ and 6 μ respectively in 80-90% yield.

6. SRI R. B. MITRA and DR. B. D. TILAK (Bombay) : *Synthesis of a Thiophene Analogue of 3-Desoxyequilenin.*

In continuation of our study of the role which an activated 9:10-double bond in phenanthrene plays in chemical carcinogenesis, synthesis of thiophene analogues of sterols has been undertaken.

Synthesis of 3:4-(3-keto-2-methyl cyclopentano)-21:2:3:4-tetrahydrodibenzothiophene (I), a thiophene analogue of 3-desoxyequilenin, starting from 4-keto-1:2:3:4-tetrahydrodibenzothiophene (II) by a six-step synthesis is under way. The synthesis is analogous to Johnson *et al.*'s synthesis of 3-desoxyequilenin starting from 1-keto-1:2:3:4-tetrahydrophenanthrene.

Compound (II) was converted to 3:4-(5-carbethoxy-3-keto-2-methyl-5-cyclopenteno)-1:2:3:4-tetrahydrodibenzothiophene (III) in four steps in an overall yield of 48%. Conversion of the latter to (I) in 2 steps is in progress.

Section of Geology and Geography.

Chairman : SHRI V. P. SONDHA (Calcutta).

XIII. EVOLUTION OF CONTINENTS.

1. SRI J. SWAMI NATH (Geological Survey of India) :

The study in Eastern Australia of the Tasman Geosyncline and its classification according to Kay (1951) has revealed the existence of eugeosynclines, miogeosynclines, epiugeosynclines and possibly an Exogeosyncline. The evidence* available indicates that the Australian Continent was evolved from west to east by a process of continental accretion, and the stratigraphic evidence also supports the hypothesis that the continents have evolved by interrupted dynamic processes leading to the reduction of oceanic areas through an intermediate 'island arc' stage.

2. SRI S. NARAYANASWAMI (Geological Survey of India) : *Evolution of Pre-Cambrian Shield of Peninsular India.*

The centrifugal arrangement of (1) the Vindhya, (2) the belt of Aravalli, Sausar, Gangpur and Iron-Ore Series rocks, (3) the Cuddapahs and Delhi, (4) the typically iron-ore-bearing schistose Dharwar, and (5) the hypo-metamorphic Charnockitic Province of rocks around the supposed oldest Bundelkhand granite is a noteworthy feature of the pre-Cambrian shield of Peninsular India. A comparison of their structural, lithologic and metamorphic characteristics suggests that the Charnockitic Province occurring in the extreme south and east of the Peninsula may be the oldest of the Peninsular Archaean. The Manganese ore-Marble Province, viz., the belt of Aravalli, Sausar, Gangpur and North Singhbhum Iron-ore Series, would be the next younger group, followed by the typically iron-ore-bearing schistose Dharwar. The unmetamorphosed Cuddapahs and finally the Vindhya are known to be the youngest of all. The schistose Dharwar are folded about a roughly North-South axis and reveal a single stage of folding, igneous intrusion and metamorphism. The Charnockitic and Manganese ore-Marble Provinces show at least two stages of folding, igneous intrusion and metamorphism, the second stage cross-folded axial trend being roughly parallel to the Dharwar axis.

On modern concepts, these correspond to succeeding periods of geosynclinal sedimentation and orogeny. The massive granitoid gneisses which make up a greater part of the Peninsula and the Bundelkhand granite may be the oldest cratons or nuclei around which these episodes have taken place and the evolution of the pre-Cambrian shield has been accomplished. In general, the pre-Cambrian shield seems to have evolved from south to north, and post-Cambrian evolution has taken place mainly to the north, moulded over the rigid pre-Cambrian shield.

The remarkable resemblance of structural patterns, periods of folding, and metamorphic grades in the Charnockitic and non-Charnockitic Provinces in India, South Africa and West Australia suggests a common mode of geosynclinal sedimentation and orogeny in such distant continents. It seems most probable that "Gondwana Land" was evolved as early as the pre-Cambrian time, but how this land was disrupted is problematical.

3. DR. F. AHMAD (Geological Survey of India) : *On various concepts about the Origin of Continents.*

The author examines the various theories on the origin of continents and points out that on the basis of a contracting earth with fixed continents, it appears

* The work was carried out in the Geology Dept., University of Tasmania under the Colombo Plan Senior Fellowship.

difficult to explain the Tertiary orogeny, the Upper Palaeozoic glaciation, and the distribution of certain important rocks, minerals and fossils, while the drift hypothesis explains these far more satisfactorily. Even though the mechanism of the movement has not been worked out, there appears to be a strong *prima facie* case for Wegener's theory.

He criticises Rode's sheet movement concept both on the basis of facts and fundamentals of geology. It is thus pointed out that the various sections quoted by him are wrong, and the entire concept is impossible.

He then examines the various reconstructions of Gondwanaland, and points out that none so far offered appears to meet the demands perfectly, but the one proposal by S. W. Carey may be the nearest approach to the original land form. Fewer attempts have, on the other hand, been made to reconstruct the northern continent, and it has, therefore, been left out of argument. If a drift of the Gondwanaland can be proved, further arguments are not necessary to prove a drift of Laurasia.

4. SRI A. K. BANERJEE (Calcutta) : *Evolution of Continents by Geosynclinal Deformation.*

A study of the geology of the continents indicates that they consist essentially of two types of structural units- the apparently immobile and stable continental shields and the mobile and unstable Orogenic belts. According to Lees (1953), the earth's crust has suffered a total compression of about 3000 km. in its orogenic belts in the three pre-Cambrian and another three post-Cambrian orogenic phases. Reasons are given to show that Lees' theory does not hold good. On similar and other grounds, Wegener's theory for continental drift and the theory of compression in the orogenic belts due to shrinkage of the earth's crust by 'heat loss' may also be rejected. Probably, the hypothesis of geosynclinal deformation by convection currents, (as shown by Vening Meinez-Griggs-Hess-DeLury) may explain well all the features of the orogens such as, mountain-building, magmatism and metamorphism. The author successfully applied DeLury's hypothesis to correlate metamorphic episodes to magmatic-orogenic events in South Knapdale, Scotland. The geosynclines are thus the clue to the story of the evolution of continents.

XIV. NATURAL REGIONS OF INDIA.

1. PROF. MANORANJAN CHAUDHURI (Calcutta) : *Natural Regions of India.*

Much of confusion hitherto exists about the term "Natural region". Very often the terms "Natural region" and "Geographic regions" are used almost in a synonymous sense. In modern geographic literature both the terms must be distinguished. The border line between "Geographic regions" and "Natural regions" is not difficult to see. The geographic region is the unit area formed by aboriginal condition, geological structure, and rock pattern, reformed and partly redefined by man. An area of earth's surface, essentially homogeneous with respect to conditions that effect human life may be termed a "Natural region", as Herbertson had put it. Thus two "Natural regions" are essentially alike with respect to conditions that effect human life. But each geographic region is distinct from the other. In a "Natural region" one can expect a number of "Geographic regions". "Geographic regions" of India in place of "Natural regions" would be a more scientific expression. The author for instance would refer to the geographic regions of India envisaged by him. About the nomenclature of the regions, no hard and fast formula can be given. This would require imaginative audacity. Sometimes, physiography would dominate the regional life. The economic condi-

tions would sometimes dominate it. The nomenclature would also be accordingly made. The geographers must be addressed to the great task of defining the regions.

Section of Botany.

XV. EFFECT OF GROWTH PROMOTING SUBSTANCES ON CROP PRODUCTION

(Chairman : DR. J. C. SEN GUPTA (Calcutta).)

1. PROF. P. K. SEN (Calcutta) opened the discussion :

The discovery of hormones in plants and inventions of chemicals having the properties of phyto-hormones have brought an unprecedented revolution in crop production in that with the application of such substances man can now control growth pattern of plants, stimulating here and retarding there, at will. Within hardly 20 years such chemicals, commonly known as growth-promoting or growth-controlling substances, have come into common practice in many spheres of agriculture, especially in horticulture, and the prospect of their use in field crops are also increasing as researches are advancing. India's contribution to such researches is also not insignificant.

In horticulture the use of growth substances have almost become a routine matter in respect of promoting rooting of cuttings and layerings. They have also been found useful in blossom thinning for controlling crop size and correcting alternate bearing, for preventing pre-harvest drops and as aids to fruit-set and production of seedless fruits.

As weed killers such substances have come into wide application in field cultivation, and researches are in progress indicating the prospect of growth substances as useful pre-sowing treatments, and for breaking or prolonging or inducing dormancy, and so on. We may hope, with confidence that in no remote future it will be possible for us, if we pursue research in right earnest, to adjust growth of crops to our climates and conditions, as they prevail, to give the best of harvests, in quality and quantity.

2. PROF. L. S. S. KUMAR (Poona) :

The remarks I shall make are entirely confined to the application of growth regulating substances to improve agricultural crops. Growth regulators used were 2, 4-D, I.A.A., N.A.A. Amongst the substances used 2, 4-D has given very promising results with seeds of wheat, javar, groundnut and rice. When treated in low concentration from 1 to 100 p.p.m. the herbicide has had a stimulate effect and has resulted in increased yield. It has been observed that response to treatment raises with the variety, soil, character, season, agronomic practice etc. It would thus indicate that it would be necessary to arrive at the exact treatment by taking into consideration the responses to the foregoing factors.

Use of growth regulators has resulted in increase in sugar content of sugarcane. The increase is of temporary duration and for higher recovery of sugar the cane has to be harvested and crushed during this temporary stimulated stage.

By use of 2, 4-D, it has been possible to control excessive vegetative growth in rice which goes under the name of "Running to leaf". The treatment restores seed-setting from 60 to 80% compared to the setting in the normal.

Use of growth regulators has been successful in inducting earliness of flowering and fruit development in pineapple and shedding of fruits in mango.

3. SRI S. P. SEN (Calcutta) : *Mechanism of Auxin Action in Relation to Growth and Development.*

How auxins may affect crop-production can be understood from a consideration of the physical and chemical basis of the mechanism of auxin action in relation to growth and development. Earlier literature is reviewed and emphasis is laid on the recent observation that growth promotion by auxins can be interpreted in terms of enzyme kinetics. The affinity of the auxins for enzymatic receptor sites within the plant and the growth response exhibited when all the receptor sites are filled with the auxin molecules concerned, are controlling factors in the growth reaction. These values can be determined and have been found to be different for different auxins. Slight changes in the structural configurations of an auxin molecule may convert it to an anti-auxin as structural requirements for auxin action in such a case may not be fulfilled.

Chemical and biological evidences are advanced in support of the contention that the COOH group in the acetic acid side chain of auxins reacts with the—SH group of Coenzyme A giving rise to a thiol ester which constitutes a high energy bond. This reaction requires an enzyme (which can be isolated from the mitochondria of a large number of plant tissues) and adenosine triphosphate but no pyridine nucleotides. Compounds resembling auxins in structural configurations but possessing no auxin-activity do not participate in such reactions. The implications of this reaction in relation to metabolic pathways controlling growth and developmental phenomena and herbicidal properties of certain auxins are discussed.

4. MR. R. N. CHOPRA (Delli) :

Work has been done on eleven plants for producing parthenocarpic fruits by artificial means : Six members of the Cucurbitaceae, (*Luffa acutangula*, *Lagenaria vulgaris*, *Trichosanthes anguina*, *Coccinia indica*, *Momordica charantia* and *Cucumis sativus*) ; two of the Solanaceae, (*Datura fastuosa* and *Nicotiana rustica*) ; two of the Papaveraceae (*Papaver somniferum* and *P. rhoeas*) and one of the Caricaceae (*Carica papaya*). Mainly two hormones, N.A.A. and I.B.A. were used both as pastes and injections, the range of concentration being from 0.05% to 2.0% in paste and from 0.1% to 0.3% in aqueous injections.

A good response was given both as regards the number and size of the parthenocarpic fruits in *Luffa*, *Carica*, *Papaver* and *Datura*. Seed development was also noticed in *Carica*, *Papaver* and *Datura* but these represented nothing but empty seed coats, except in the case of *Datura* in which a tumoral outgrowth was observed inside the ovules. Such an outgrowth has also been reported by Van Overbeek *et al* (1941) in *D. stramonium*, and by Sattina *et al* in certain incompatible crosses in *Datura*, and has been designated as "pseudoembryo" by the former authors.

5. DR. S. K. MUKHERJEE (Krishnagar) : *Effect of hormones in rooting of fruit plants.*

Fruit trees are generally propagated by vegetative methods to maintain the superior quality of fruits of the selected plants. The common processes employed are grafting, budding, cutting and air layering. The last two methods require induction of root formation from the stem. Some plants root easily e.g. mulberry, citrus, litchi etc., whereas others do not easily give out roots by the common methods employed e.g., mango, jack-fruit etc. Since the discovery of the effect of hormones in promoting root development, a large number of chemical substances have been tried on various plants. Some trials on the effect of hormone in rooting of air layers of mango (*Mangifera indica* L.) jack-fruit (*Artocarpus heterophyllus* Lam.) and rose apple (*Syzygium jambos*) have been undertaken at the horticultural research station, West Bengal, Krishnagar.

Twentyfive shoots (2 years old) of each type were treated with Seradix B 3 (May and Baker) and 25 kept as control. About 1½" wide rings of bark were removed from the selected twigs, about 18" below the tip, and the exposed portion dusted with Seradix powder. After removing the excess powder, it was covered with moist sphagnum and wrapped with alkathene (I.C.I), two ends of which were tied tightly with twine. This was repeated every month from April to September. When the air layers gave out roots they were lowered from the plant and potted. •

The results show that jackfruits respond favourably to the treatment. In the control four have rooted none of which survived after potting but sixty have rooted among the treated ones, thirtyone of which survived after potting. Maximum amount of root development taking place during the months of July to September. In roseapple, maximum rooting took place during the month of April, and difference from the control lay mainly in the quickening of the process of root formation. In the control, it took about 9 to 10 months to produce roots whereas in the treated plants it took 2½ to 3 months. Mangoes have not responded so well to the treatment. There was no rooting in the control. Only 25 among 50 treated plants produced roots out of which only 11 survived after potting.

The present observation is of special practical importance in the case of jackfruit and in the roseapples. Jackfruit is one of the important fruits in West Bengal and Malabar where it occupies a major area. It is a good fruit and can also be used as vegetable. The present practice is to raise the plants from seeds, which does not allow maintaining uniformity in the quality of fruits. The seedling plants also take a long time to bear fruits. The success of the present method opens up a very promising line for the propagation of jackfruit and in its widescale application for propagation of jackfruit. The method is quite easy to handle even by common growers as a nursery practice and will not entail much cost. Vegetative propagation of jackfruit will also ensure maintaining uniformity of characters of the clonal selections.

Propagation of roseapple is likely to be done within one season by the present method, which will be also of practical importance. Mango propagation by gooties may not be practiced widely in preference to the present method of inarching, but the present method will be of importance in raising of uniform stocks and their standardisation.

6. DR. S. M. SIRCAR (Calcutta) : *Growth Hormones in Rice Plant.*

Growth hormones in rice plant are being studied in this laboratory in order to understand the onset of flowering. Methods of assay of hormone content in rice plant have been standardized. Preliminary work indicates that rice endosperm contains large quantity of hormone which disappears during germination at the room temperature. Low temperature vernalization results high auxin content in the endosperm whose action is manifested in the early growth phase-tillering, but no acceleration of flowering. Relation of the auxin content in the different fractions of the endosperm with the growth of the seedling and the effects of the application of hormones on the growth of the isolated embryo have been studied.

Application of Indoleacetic acid and Naphthalenacetic acid at a later stage of the plant by spraying has resulted early ear emergence, the effect being noticed at the initiation of floral meristem.

7. SRI SALIL KUMAR CHATTOPADHAYA (Darjeeling) : *Effect of hormones on fruit-set and seedlessness.*

Pollination of the flower is essential to the formation of fruits of most kinds of plants. The development of fruits without seeds from unpollinated flowers, while a comparatively rare occurrence, is nevertheless familiar. In natural parthenocarpic pollination either does not take place or is ineffective in bringing about fertilisation

and seed development. Gustafson (1936) first applied specific chemicals of the nature of hormone and obtained mature seedless fruits with pollination. Today hormone-induced parthenocarpy and seedlessness of different fruits have attracted a number of modern workers, who are engaged in finding out greater details of the problem.

Analysis of the results obtained by different workers in India shows that tomato plants (*Lycopersicum esculentum* L.) more or less respond favourably to hormone treatments. Thus in tomatoes, an increased yield was noted by Randhawa & Thompson (1949) and by Randhawa (1950-51), while marked seedlessness was noted by Venkataratnam (1950) and by Singh & Kacker (1952), by treatments with hormones. The experience of the present author (1954) shows that of the three hormones tried (IBA, IAA & NAA), IBA caused a greater percentage of fruit-set in comparatively lower concentrations when applied on three consecutive days. The same hormone induced seedlessness in higher concentrations markedly. Of other fruits, *Hibiscus esculentus* L. showed pronounced seedlessness with IBA at anthesis treatments, *Citrullus vulgaris* Schrad exhibited the same effect with NAA at post-anthesis treatments and *Cucurbita pepo* DC failed completely to all the treatments. In addition, post-anthesis treatments with *Hibiscus esculentus* L. produced larger sized fruits.

It is worth while to mention the physiological basis of hormone-induced fruit-set. Gustafson's (1942) view of normal development of fruit is that growth of the ovary following fertilization is brought about by auxin introduced in the pollen, whereas naturally parthenocarpic fruits are produced through the influence of auxin present in larger quantity in the ovary than occurs in those varieties which require fertilization for fruit development. In addition, it may be stated that where this natural supply of auxin is inadequate, it may be corrected by the application of synthetic hormones, which induce changes in the ovary duplicating those normally brought about by pollination. The result is the development of seedless fruits artificially. And lastly, the treatments at post-anthesis stage of flowers led to the accumulation of larger dosage of mixed hormones: from pollen as well as of specific chemical hormones used in the treatment. These caused increased cell-expansion in developing fruits leading to their bigger sizes.

8. DR. R. D. ASANA (New Delhi) (In Absentia) : *Influence of Plant Hormones on the Growth of Wheat.*

As a result of experiments, conducted during the last five years, it has been found that application of beta-indoleacetic acid and alpha-naphthaleneacetic acid (infiltrating through cut leaf-tips or as spray) significantly increased the grain yield of wheat raised under pot-culture. The increase in yield was brought about as a result of increase in one or the other ear character. A similar favourable effect was also obtained in one season under field conditions. It appears necessary to determine the causes underlying the inconsistency of the effects of the growth substances on the various characters.

It is suggested that while auxins cannot as yet be applied directly for increasing crop production, research on the fundamental aspects of the problem would be worthwhile.

9. DR. S. KRISHNAMURTHI and SRI D. SUBRAMANIAN (Annamalainagar) (In Absentia) : *The Use of Growth Promoting Substances in Vegetable Production.*

Much has been accomplished in improvement of vegetables by the application of growth promoting substances by increasing fruit-set, size and yields, besides inducing parthenocarpy and improving quality of fruits. Among the growth regulators used, substances from the group of substituted phenoxy, naphthoxy,

naphthalene and indole compounds have been important. The results achieved in tomato, bean, brinjal, pepper, cucumber, pumpkin and water melon, are summarised below :

Tomato has received most of the attention. In the green house studies, the fruit-set in tomatoes has been increased by application of certain growth regulators and such applications supplement pollination which is poor under conditions of low light and low temperature at the time of flowering. The total yield is increased due to the effectiveness of 'hormones' in making the blossoms set fruit and in preventing abscission of flower-buds and fruits. Early yields obtained by various 'hormone' treatments coupled with an increase in the average weight per fruit fetch better prices in the market. The use of growth substances in the tomatoes for improving yields and fruit-set on a field scale has resulted in somewhat contradictory data. The use of whole plant sprays as compared with flower cluster sprays has at times reduced the set of fruit probably because of the inhibitory effect of growth substances upon the young flower buds. Studies carried out in other countries reveal that 2, 4-D (2 to 5 ppm), p-CLPA and L-(p-CLP) propionic acid (25 ppm), 1-naphthoxyacetic acid (25 to 50 ppm) have been effective for increasing yield and hastening maturity in tomatoes. Studies conducted at Annamalai University on tomatoes with Ammonium salt of 2, 4-D increased fruit-set by 189 per cent over the non-treated.

In Brinjal, at the Annamalai University, interesting results in inducing parthenocarpy and early maturity and increasing fruit-set and yields have been obtained in small scale trials with the use of 2, 4-D, B-Naphthoxy acetic acid and L-Naphthelene acetic acid. Application of certain growth regulators like B-Naphthoxy acetic acid and naphthalene acetic acid has resulted in increasing crop yield in snap beans. In pepper, successful results of parthenocarpy have been reported with the help of growth regulators; but attempts have been too few regarding fruit-set and yields. In cucumber, indole acetic acid, naphthalene acetic acid and chlorophenoxy acetic acid have been among the substances used for this purpose with some success. In pumpkin, success in inducing parthenocarpy with the use of plant growth regulators has varied according to the varieties. In general, naphthalene acetic acid appears to have been more useful in inducing parthenocarpy and increasing fruit-set. Among other substances tried and found fairly successful were indole butyric acid, 4-fluorene acetic acid, pyrrole- α -carboxylic acid and pyrrole- α -acetic acid. In water melons, for inducing parthenocarpy, generally, a mixture of chemicals has been somewhat more effective than single substances, and in such mixtures, naphthalene acetic acid as a component has been comparatively more successful.

Studies made on the composition and nutritive value of 'hormone' treated fruits compared to non-treated fruits of tomato have shown somewhat varying results, but in many cases increase in total sugar content has been reported.

It can be generally concluded that immediate causal factor in fruit setting is 'hormonal', provided nutrition is adequate. The most profound influence on the yield and fruit-set of crops reported as responding to the application of growth substances is obtained, when the prevailing environment is not conducive to normal fruit-set. So far, most work has been done on tomatoes. The opportunities for the improvement of other vegetables with growth-regulators are unlimited, provided the proper techniques are developed to utilise such resources.

10. SRI K. KUMAR, SRI K. L. MUKHERJEE and SRI R. SINGH (Banaras)
(In Absentia) : *Effect of I.A.A. and P.A.A. on the growth and yield of Tomato and Onion.*

Tomato and onion were grown in sand with Hoagland's nutrient solution (complete, -N, -P, -K) and in well-manured soil. I.A.A. (indole-3-acetic acid) at

0.15–1.00 ppm. concs. and P.A.A. (Phenoxy acetic acid) at 0.008–0.80 ppm. concs. were applied as growth substances to sand pots and at 0.1 ppm. (I.A.A.) to soil pots.

Growth character study reveals that I.A.A. at concs. 0.15–0.30 ppm. and P.A.A. 0.008–0.08 ppm. were either slightly stimulative or ineffective in producing better growth, while higher concs. were toxic. -N, -P, -K when supplemented with hormone (I.A.A.), -K was found to be effectively replaced by hormone, -P partially, while it was of no use for -N. Application to soil brought significant increase in growth. Reasons tendered are that plants grown under optimum environmental conditions are not deficient in growth substances. Additional application is either a luxury consumption or proves toxic. Stimulative effect in soil culture may be attributed to its effect on the complex micro-flora of soil rather than to the growth substance directly. Increased growth in potassium deficient plants by hormone treatment shows that potassium deficiency may possibly be associated with decreased hormone content. In other cases (-N, -P) the nutritional factor itself may be the reason for decreased growth.

11. SRI B. SEN (Almora) (In Absentia) :

It has now been well established^{1, 2} that plant growth substances have regulating influence in all phases of plant life—germination of seed and sprouting of tubers, elongation and differentiation of cells, formation of roots and shoots, floral initiation, fruit set, fruit growth and fruit drop. The discovery, identification and synthetic production of many plant growth substances have raised great hope for a spectacular improvement in crop production. Except for controlled initiation of flowering in pineapple, however, no outstanding results with other crops have yet been reported, though spraying of growth substances for control of fruit set and fruit drop has now become a standard practice in progressive apple and pear orchards. Where agricultural industry is mechanised, indirect contribution to crop production by the use of growth substances which form the basis of modern selective herbicides such as 2, 4-D, methoxone, 24, 5-T has been substantial.

It is only in micro and sub-micro concentrations of growth substances that stimulating effects are induced in plant organs, and it has been found that in certain cases the regulatory stimulating effect of growth substances can be duplicated or bettered by the use of micro-elements. For instance, the germination and length of pollen tubes (which are important factors in effective fertilization) are stimulated in Madonna Lily by micro and sub-micro concentrations of most of the growth substances, but greater stimulating effect can be induced by micro-concentration of boron in the germinating medium.³ Again, shortening of the vegetative phase, as also of the node number at which flowers emerge, of Mustard T. 102 can be induced by soaking the seeds in micro-concentrations of growth substances, but greater shortening of the vegetative phase without any shortening of the node number can be induced by soaking seeds in micro-concentrations of boron or manganese.⁴ Since growth substances have stimulating effect in micro and sub-micro concentrations but are toxic at higher concentrations, it is essential to determine the optimum concentration of growth substances in different plant organs and their supply-potential at different stages of development. Until we have such knowledge, agriculturists and horticulturists are not likely to derive the benefit of controlled crop production which the proper utilisation of growth substances should make possible.

12. DR. R. S. CHOUDHRI and SRI R. RAJAGOPAL (Banaras) (In Absentia) :

Study of the naturally occurring auxins and chemically synthesised, physiologically active growth regulating substances reveals that the growth behaviour of plants can be effectively controlled to fit into our needs. Various called, these hormones profoundly influence plant growth in minute concentrations by inducing morphological, histological and physiological changes, even in organs far away

from the site of application. Used as acids, esters, amides and salts, one being preferred over the other depending upon their solubility, volatility and availability. Spraying, dusting, soil treatment, exposure to vapours, dipping in solution and lanolin paste application, are the chief methods of application in vogue, the duration of treatment depending upon the nature of the plant and the intrinsic property of the chemical used. Caution is to be observed in using these, as higher concentration and duration or improper time of application, may result in retardation or inhibition of crop growth. Higher percentage and speed of germination, initiation of good rooting, increased tillering, earlier blossoming, prevention of blossom and fruit-drop, prevention of premature bolting, induction of parthenocarp, better fruit-set coupled with good quality, resistance to some diseases, and higher yield are some of the significant results recorded and reported in a variety of crop plants. Help crop production indirectly by their selective herbicidal action without detriment to the crop plant. "Without hormone, no growth."

13. DR. R. S. CHOUDHRI (Banaras) (In Absentia) : *Studies of the effects of certain plant hormones on growth, general behaviour and food transport of Phaseolus Vulgaris L.*

These extensive investigations were carried out at the New York State College of Agriculture, Cornell University, U.S.A., by the author during the years 1946 and 1947, black wax bean (*Phaseolus vulgaris* L.) being used as a test plant. Several plant hormones representing different groups and their derivative salts were used in different concentrations to treat the different parts of the plant. The susceptibility of different plant parts or organs depended upon the structure and the age of the constituting tissues. Following treatment of one part or the other, the noteworthy features were, the movements of the growth substance and of the plant food respectively. Whereas the former, specially the phenoxy compounds, could move to long distances from the site of application, the food migration was contrariwise greatly inhibited depending upon the dosage administered, and if at all, it moved to the treated site from regions remote. This was obvious by the increased weight of treated parts and by the characteristic thickenings observed at site and in the vicinity of the treated region. Such treatments delayed the usual abscissions of plant organs (such as those of cotyledons, leaves, buds, flowers, fruits etc.), limited the growth of parts located distantly from the venue of hormone application, stimulated axillary growths, induced many different types of formative effects and initiated seedlessness in fruit pods. All such effects seemingly resulted from a tendency of these hormonal substances to prevent or at least to inhibit the migration of food from the seat of hormone application. Mere treatment of leaves (which form the main source of food supply) resulted in a set back of root growth and even in the nodulation tendencies, evidently due to lack of carbohydrate supply. Only lighter dosages supplied to seeds in the form of pre-sowing treatments, could stimulate germination of seeds.

In view of the marked effectiveness of these wonder chemicals of hormonal nature on food movement in plants, the choice and dosage of treatment has had to be highly judicious and the purpose of using them had to be kept in forefront viz., whether it is intended to improve seed germination, to stop leaf-fall, to induce early blossoms, to prevent fruit drop or to initiate seedlessness.

11. DR. S. C. CHAKRAVARTI (Bhopal) :

It has not yet been conclusively proved that the application of growth promoting substances can increase yield of crops directly. Nagato and Sato of the Nagoya University, Japan, recorded better fruiting in paddy with pre-transplanting hormone-treated seedlings, only when the plants experienced an adverse environ-

ment in the latter period of growth. Experiments in India along similar lines might prove to be fruitful.

With the exception of pine-apple, almost all the experiments where an early flowering has been induced through the application of hormones, are confined to non-crop plants. Chakravarti and Pillai have, however, been recently successful in inducing early flowering in mustard through spraying treatment of seedlings. Observation of Leopold on an increase in the number of floral primordia in Wintex barley by an application of IAA or NAA is worth giving trial with other cereals crops in this country.

Vernalization induces early flowering in a few crop plants and that too is accompanied with a decrease in yield. Recent work of Leopold and Guernsey on "chemical vernalization", in inducing earliness in flowering in several non-vernalizable crop plants and of Chakravarti and Pillai in the induction of an additional earliness in flowering in mustard over that obtained by vernalization alone, through a pre-chilling-hormone-treatment, are of interest.

Suitable trials should be undertaken to evaluate the possibility of "chemical vernalization" on crop production.

DR. R. N. SINGH (Banaras) and DR. B. SAMANTARAI (Cuttack) also participated in the discussion. PROF P. K. SEN wound up the discussion in the end. The Chairman summarised the contributions of the various participants. He pointed out that, while some practical results have been achieved, elucidation of the mechanism of the action of the growth hormones has not been explained adequately from the fundamental point of view and hoped that it will receive the attention of the workers in the field.

XVI. APPLIED ECOLOGY.

Chairman : DR. J. C. SEN GUPTA (Calcutta).

1. SRI K. L. AGGARWAL (Dehra Dun) opened the discussion.

He said that the study of the subject of Applied Ecology came into prominence only recently to meet with the shortage of food, fodder and fuel after the Second World War. He pointed out the necessity to bear in mind the two basic concepts of Ecology namely, (i) Plant succession and Climax and (ii) Plant Indicators while studying Applied Ecology problems in Forestry, Agriculture, Soil Conservation, Preventing erosion, Flood Control, Fish Culture etc., and illustrated as to how these two concepts help us in the study of Applied Ecology in the above mentioned fields. He also pointed out the desirability of fundamental studies in Ecology which would ultimately aid in the solution of problems of the applied aspects.

2. SRI S. K. SETH (Naini Tal) : *Applied Ecology in Forestry.*

In the field of forestry, ecology has its principal application in the techniques of silviculture. These may be broadly classified into four sections according to the ecological approach involved :

- (i) Silvicultural systems with natural regeneration.
- (ii) Silvicultural systems with artificial regeneration.
- (iii) Subsidiary silvicultural operations.
- (iv) Introduction of exotics.

The first desideratum is a practical classification of forest types. It is in this perspective that the above four categories should be considered. Under the first category are included the standard techniques of natural regeneration which are examples of applied ecology restricted and conditioned by management patterns.

The second section deals with artificial propagation of plants and illustrates the application of fundamental ecological principles although on a restricted scale. The third section embodies somewhat localised practices which find their main application inside the broad framework of silvicultural systems but are more purely ecological in nature. The last category treats of an aspect of forestry in which the correct evaluation of complex ecological factors should precede experimentation and where eventual success may depend upon the nicety with which ponderable and imponderable factors were assessed. Examples are sited and discussed.

3. DR. R. MISRA (Saugar) : *Some Plant Indicators of Sagar (M.P.)*.

(a) *Physiographic Indicators*.

Carissa spinarum is an indicator of intensive erosion on hill slopes of tap areas. The plant propagates rapidly from the exposed root suckers. *Capparis sepiaria* with a similar habit is found to colonise bad lands of the upper gangetic plain. *Zizyphus rotundifolia* on the otherhand thrives on foot of hills and such areas which receive deposits from higher lands. It grows in circular patches and the covered stem assumes a rhizomatous character with sprouting shoots. Thus these species can be used in the indicated situations for rapid reclamation.

(b) *Indicators of Soil Conditions*.

Cassia tora and *C. obtusifolia* indicate recently disturbed soil. They grow on excavated and deposited soils, along drains, streams, roads and mango groves. Thus soil aeration is indicated.

Enicostema littorale grows on well drained soil in meadows. According to increasing duration of waterlogging *Cyperus* spp., *Ischaemum rugosum*, *Saccharum spontaneum*, *Chrozophora rotleri*, *Heliotropium supinum*, *Polygonum plebejum*, etc., grow respectively in depressions. The seeds in these cases rot in water before germinating. Thus these plants indicate drainage conditions.

Spermacoce stricta populations correspond with the iron content of the soil. *Woodfordia floribunda* on eroded soils and *Choris virgata* on stabilised soils indicate lime content. *Lippa nodiflora* and *Rumex* spp. indicate nitrate content. Thus these are chemical indicators.

(c) *Indicators of Grazing*.

As the intensity of grazing increases the following species occur in the grasslands in order of range deterioration—*Themeda caudata*, *Iseilema antheaphorides*, *Schima narcosum*, *Dichanthium* spp., *Bothriochloa pertusa*, *Sporobolus diandar*, *Eragrostis* spp., *Urochloa reptans*, *Indigofera ennaephylla*, *Manisuris gracilis*, *Eleusine aegyptiacum*, *Indigofera cordifolia*, *Melanocenchrus cenchroides*, etc.

(d) *Aquatic Plant Indicators*.

Utricularia spp., *Ottellia alismoides*, *Chara* spp., *Splrodella* sp., *Wolisia* sp., and myxophyceae indicate polluted water. *Limnanthemum* spp., *Nelumbium speciosum* and *Potamogeton* spp., indicate rapid silting. *Potamogeton crispus*, *Hydrilla verticillata* and *Ceratophyllum demersum* indicate hard water.

It is suggested that plant indicators are useful in afforestation schemes and designing management of land and water.

4. DR. C. B. RAO (Rajahmundry) : *Small Sheets of Water, their Algal content and Fish Culture*.

Small sheets of water, though situated in the same neighbourhood and on the same geological substratum and appearing apparently identical in character, harbour varying algal flora, the flora being widely different and characteristic of each. These variations may be attributed to the variations in the chemical com-

position of the water in each case. For studying the influence of the chemical factors on the algal flora, smaller sheets of water are more suited than larger ones because the former react to changes in the environment more quickly than the latter.

Observations on a few small sheets of water in a temperate zone have indicated that flagellates are more numerous in acidic ponds than in alkaline ones. Among acidic sheets again, those with a higher C/N ratio and a higher concentration of total iron harbour a higher percentage of Euglenineae. Green algae (Volvocales, Chlorococcales and Desmids) were poorly represented in sheets of water with a high concentration of albuminoid ammonia and a low quantity of oxygen. Diatoms were in larger numbers in alkaline ponds than in acidic ones. The alkaline waters also showed higher bicarbonate content and more total dissolved solids than the acidic ones. Blue green algae were plentiful in waters having high organic matter and low O₂ concentrations, besides pH around neutrality.

Distinctly acidic sheets of water and distinctly alkaline sheets of water harbour richer floras, though widely different in nature, than water sheets around neutrality. The algal flora of any sheet of water could roughly be a pH indicator.

Sheets of water observed in South India confirm the findings given above regarding green algae and blue-green algae. Flagellates, however, are to be associated with waters around neutrality and usually having higher C/N ratio. Distinctly acidic tropical sheets of water are not come across by the writer and therefore not studied. Waters with lesser concentration of oxygen and a rich iron content show larger numbers of Euglenineae. Higher C/N ratio and a maximum algal population show a correlation.

By making use of knowledge regarding food chains of fish noted for fish-culture, one could readily associate a particular fish group with a particular sheet of water and obtain desirable results in fish-culture.

5. DR. R. N. SINGH (Benares) :

Pointed out the application of Micro-organisms in the field of Ecology and felt that reclamation of usar soils may be helped by studies on Blue green problems in India. He also suggested that it may be possible to replace *Chlorella* by *Anabaena* while dealing with unconventional food production.

6. PROF W. H. PEARSELL (London) :

Participated and dealt with sets of problems in Applied Ecology. The problems of Applied Ecology include those of water, swamp and terrestrial soils of which examples have already been given. He pointed out the possibility of improving soil conditions by using appropriate ecological methods. As an illustration an example was given of experiments designed to improve run down soils, depleted either by bad land area, by climatic deterioration or by uncontrollable silvicultural-treatment. These experiments have been set up by the National Conservatory in Britain. They consists of plots on run down soils each containing a single tree species of plants which are believed to alter the character of the soil by controlling leafy and other detracts to the surface. Some are believed to raise the Nitrogen status and other the status in certain mineral materials such as Calcium and Potassium.

7. PROF. SUKACHEV (U.S.S.R.) :

To my mind Mr. Ranganathan was quite right when, in his address he said that silviculture is Applied Ecology. This was once more shown in the reports of Dr. Aggarwal and others. I may go further and even say that agriculture and

forestry, if we understand these words in wide sense, are Applied plant Ecology, including into it Phytosociology.

This, to my great regret is not sufficiently recognised. In particular not enough attention is paid to the training in these branches of Botany in the Agricultural Colleges. In the universities of U.S.S.R. special geo-botanical laboratories can be found, where students are trained in Ecology, Phytocenology and Plant Geography. Phytocenology in the U.S.S.R. is widely used in Forestry in the growing of grass and when cultivating the fodder plant. In the main questions which arise in the mixed strands of trees and grasses—are the forms of combinations of plants and their density and these are of phytocenological significance and with the help of its datas, the questions are solved. Now in plant Ecology and Phytocenology the following problems stand before us—

(a) To make a survey and to put into order all the extensive data already published in big number of books on Autoecology and Phytocenology, but this is not enough. These data must have such an interpretation so as to be of direct use for the grass and forest growing. This is a big task and I would say not an easy one. It could be done only by scientific workers who are equally well informed as in theoretical questions of Ecology, as well as in different branches of Forestry and Agriculture.

(b) As in forestry and Agriculture the stands of crops usually are created more or less dense, so along the investigating the relation of plants to the factors of the environment. (Climate, Soil fauna). It is necessary to do more research experimental work to study the coaction of plants, in the case when a number of plants grow side by side. This coaction may be of good or bad character. In other words the movements which are included in Darwin's 'Struggle for Life' be studied. Experimentally this has not been largely investigated but for applied Phytocenology it is of the utmost importance.

(c) Special Ecology—Phytocenological stations or, to say more accurately, biogeocenological stations in definite plant associations in nature itself should be organised. These stations should be of complex character where the vegetation (from the ecophysiological point of view) is studied along with all other factors of the medium and with the relations to the vegetation. It is of special importance that in these stations works of experimental character should be conducted in a wide scale i.e. they must lead to the development of experimental Phytocenology.

(d) The teaching of the Ecology and Phytocenology in Colleges and Universities should go on in a more wide scale.

8. PROF. MOLTCHANOV (U.S.S.R.) :

Besides the description method of investigating the Ecology of trees and their communities in our country much attention is paid to these factors of the medium which influence the germination of seeds, growth and development of plants. When investigating these ecological characteristics of plant growth the microclimate and the water regime of the soil are studied in detail. In other words the bioclimatic conditions of different forest and agricultural crops are cleared out. In this case special attention is paid to the reaction in the growth and development of plants on the changes of temperatures, humidity of the air, light conditions, humidity of the soil and its general fertility. It is already a long time that in the U.S.S.R. the meteorological determinations are made as under the canopy of the trees, in different types of forests and also on open spaces covered with grasses or agricultural crops. Along with the investigations of the bioclimate of the forests much consideration is also given to the microclimatic conditions of the fields adjoining to the forests and also of the shelter beds and the areas between them.

The microclimate is investigated with the help of specially set up meteorological stations. At these stations the units are fixed on the surface of the earth,

five centimeters above it, just over the grass cover and 200 centimeter above the crowns of the trees. At the same places the humidity of the soil upto 360 centimeters is determined with help of evaporators the evaporation from the surface of the vegetable cover, soil surface and the transpiration of this cover are also determined. The light conditions are cleared up and the different stages of plant development and specially the increase in height and diameter are determined.

As to the grass cover, the phases of its development are fixed, its mass in weight units and increase in height are determined. The forest bioclimatic stations are set up in the more widely distributed types of forests, in the trees-stands consisting of different species and also in forest of various age and density.

The fields covered with various crops the stations are set up at different distances from the forests or shelter-belt.

The following distances from the shelter-belt or forest in meters can be proposed 10, 50, 100, and 250. On the basis of the data obtained, the relationship of growth and development of plants according to the temperature, humidity of the air and soil, precipitation, light conditions and evaporation are determined. As experiment has shown the bioclimatic investigation of this kind are helpful in establishing the methods of degeneration and conditions of growth of coppies after selection, cutting and thinnings. They also help to find out the productivity of the stand as a result of changes which take place in the factors of the medium when different thinnings are conducted. It is possible to determine the width of clear-feelings which will be optimal for the growth and regeneration of coppies, the direction of these feelings according to the compass, and also to find out the distance between the shelter-belts, which will be optimal for the growth of agricultural crops.

9. DR. G. S. PURI (Dehra Dun) :

Mr. K. L. Aggarwal in his stimulating opening address has broadly indicated the numerous fields of human endeavour in which plant ecology has been used or has future possibilities of service. Other speakers have indicated other fields in which ecological techniques find application.

I shall confine my remarks to the common techniques of applied ecology that have been used in this country, with varying success.

The development of vegetation is controlled by climate, soil and biota and a change in vegetation can be effected by changing one or more of these factors.

It is extremely difficult, if not impossible, to bring about by artificial means, any fluctuation in climate, large enough to upset the normal course of succession. I do not minimise in this connection the probable role of artificial rain making, but this is as yet a far cry. No one therefore attempts at the change of climate in applied ecology. But by creating in conopy small openings modification in micro-climatic conditions of the forest has been brought out. For example light intensity, temperature etc. have been changed by manipulating the conopy in some sal, deodar and silver fir forests of India.

Soil conditions can be changed, though to a limited extent; the change being most phenomenal in the humus layer. It is this layer, which mostly matters when dealing with applied ecology.

The common techniques that are in use in this country are hoeing, mulching, contour trenching, etc. in forest areas. The exact ecological changes resulting from these techniques have not been studied adequately in Indian forests but moisture conservation, aeration or distribution of food material in the soil body is presumably the result. The operations are done to stimulate the growth of tree seedlings and that ultimately results in the acceleration or retardation of succession along a particular line.

In some areas, the above techniques have helped in the perpetuation of sal and silver fir communities by retarding the successional development of vegetation to communities with less important species.

The biotic factor is the most powerful and most commonly used, for its low cost and maximum effect, in applied ecology.

The conversion of grassy areas to *Pinus longifolia* in some tracts of the Siwaliks is achieved by mere closing it to grazing. The regeneration of some *Strobilanthes-balsam* type of silver fir forests has been claimed by grazing. Fire helps the regeneration of *Pinus longifolia* and inhibits those of silver fir and spruce. In raising artificial plantations of a number of species the vegetation is clearfelled, debris burnt, and ashes scattered before re-planting the area. The present state of most of the sal forests is considered to be due to fire conservancy, giving sal an advantage over other species.

Shifting cultivation in the past has been a powerful tool in upsetting the normal course of succession. The predominance of blue pine and deodar forests in large tracts of Kulu and Bashahr Himalayas is due to partly shifting cultivation. The normal climax here is *Quercus incana* community, and lopping, felling fire have destroyed it from large areas.

The planting of conifers in a number of hill stations, e.g., Simla, Mussoorie and Chakrata has altered the nature of succession considerably. Mention may be made of *Cryptomeria* plantations in Darjeeling district and *Casuarina* on sea coast. If allowed to stay for long enough periods of time these may modify the successional development of indigenous vegetation in the area.

The practice of weeding, shrub cutting, thinning, forest management especially improvement felling, brings about large changes in the normal successional development of vegetation.

Although the above techniques in applied ecology have been in use for a long time the fundamental data regarding these have not been collected so far. The necessity of such fundamental studies has now been keenly felt and the Symposium on "Vegetation Types of India" has formed on "Indian Council of Ecological Research." This council includes specialists in Soil Science, Agronomy, Soil Conservation, Zoology, besides foresters and Ecologists. It is presided over by the Inspector General of Forests, Government of India and is to co-ordinate and expand ecological studies on all types of vegetation in India. It will also help in the planning of applied ecological research in different fields of human activities.

10. F. R. BHARUCH (Bombay) dealt with grass land improvement and socio-ecological point of view.

11. P. S. SRINIVASAN :

It is gratifying to note that an ad-Hoc committee consisting of experts in various branches concerned such as Botany, Agricultural Meteorology and Silviculture has been recently formed with view to advance the science of Applied Ecology in India. Also Dr. F. R. Bharuch indicated that the study of distribution of flora and fauna in India will be taken up immediately. I feel that the value of such a survey will be very much enhanced if the 'intensity of distribution', "population studies" of flora and fauna of India is made. This can only be accomplished by restoring to sampling technique and hence the first step should be to evolve the most suitable sample size and structure to find out the percentage to be sampled to yield the necessary information to the required accuracy or precision.

Also if possible side by side with this survey the study of environment that has given rise to the particular development of flora and fauna should be undertaken. This aspect of the study was rightly stressed by the visiting foreign delegates from U.S.S.R.

12. PROF. SHANTI SARUP (Jodhpur) (In Absentia) : *On some Problems in the Immobilisation of the Indian Desert.*

The main problem of the selection of species to be used for the control of the loose sand is twofold—(i) the selection of species for perennial cover and the selection of species for cover during the rainfall. Of the local perennial species, *Prosopis spicigera* Linn and *Calligonum polygonoides* Linn might be used to some extent. *Prosopis juliflora* DC. (P. grandulosa) which is less woody and grows more rapidly, however is more suited than the native species. It coppices well and regenerates naturally. Its water requirements are also not so great as that of other species tried in deserts in other parts of the world. It is also suitable for covering the rocky areas and some parts have been successfully afforested with this.

Calligonum polygonoides Linn is also a useful plant for being introduced in the interior of the desert.

During the rains the commonest plant is *Tephrosia purpurea* Pers. It covers the soil. The root and dry branches remain in the soil even after the rains and may continue as such till late in the season. It is probably a recent introduction and is spreading quickly. Its cultivation along with those of other species should be extended into the interior of the desert. It is also useful for covering the sand dunes. At such places *Saccharum spontaneum* Linn has proved very useful.

These species are able to some extent to control water erosion.

Some of the other lines of work in this direction with problems of their own as discussed in the paper are :—

- (a) The improvement of grazing lands by rotation, closure and the introduction of legumes.
- (b) There is constant breeze in the desert for major part of the year which could be used :—
 - (i) for wind mills for drawing water and as a source of energy for other purposes.
 - (ii) As an aid for artificial rain making during the period it is charged with moisture.
 and whose effect is to be counteracted by
 - (i) Road side planting and planting along railway tracks.
 - (ii) Wind breaks, shelter belts, development of oases etc. to minimise wind erosion, dessication and march of the desert.
- (c) The problem of salt in the soil and its removal by planting.
- (d) The control of destruction of vegetation and deterioration of the area.
- (e) Co-ordination of studies and afforestation work done by the various agencies and the public sector and formation of an overall organisation.

13. SRI GURDIAL SINGH LAMBA (Jodhpur) (In Absentia) : *Fixation of Shifting Bands in the Indian Desert by means of Vegetation.*

The Indian Desert occupies an area of approximately 80,000 sq. miles. Its control and reclamation might provide new land for the surplus population of the country. This desert is not treeless, rainless and uninhabited piece of land. It is believed that it was well wooded and fertile two to three thousand years ago and desert conditions have set in the recent past and are gradually accentuating. Due to excessive uncontrolled grazing and unwise exploitation of natural resources by man, wind erosion has set in and stabilised sand dunes are being transformed into mobile shifting sands. Thus the slow work of nature which was going on for centuries in stabilising the sand dunes has been reversed and moving sands are engulfing the rich adjoining fields, and smothering walls, buildings, roads and railway tracks. These mobile sands can be reflexed by protection and conservation of existing natural vegetation supplemented by artificial work.

The first essential is to arrest the movement of sand by mechanical devices temporarily but vegetative cover must be established for permanent reclamation. Wooden pallisades or fences may be erected to break the force of wind and catch sand. The best way of arresting movement of sand is to spread corn-stalk, brush wood or town refuse and to simultaneously sow and plant sandbinding grasses, shrubs and creepers but is rather expensive. Another method is by planting fast growing species in belts of 3 or 4 rows at about 200 feet intervals. In a few years the growth in the belts will be sufficient to afford adequate protection to anything planted in between. Grasses and shrubs growing naturally on blown sands are recommended to be sown or planted first. After the site have become stable, local tree species or exotics can be green. In course of time with the addition of humus, the soil may become suitable for growing even agricultural crops.

The Chairman summarised the observations of various participants and spoke stressing on the desirability of intensive study of Ecology both in its fundamental as well as applied aspects

Section of Zoology and Entomology

Jointly with the Sections of Botany and Physiology.

XVII. STRUCTURAL PHYSIOLOGY OF THE CYTOPLASM.

Chairman : DR. P. SEN (Calcutta).

1. PROF. VISWA NATH (Hoshiarpur) :

It is difficult to name a more comprehensive, if not a more intriguing, subject for discussion. It is, therefore, in the fitness of things that our sectional committee decided to have a joint discussion under the auspices of the sections of Zoology, Botany and Physiology.

Our President was kind enough to ask me some time ago to open the discussion. I readily accepted his kind invitation; but as I sit down to prepare an abstract of my talk and survey the bewildering variety of cells in the animal and the plant kingdoms, I feel that it is impossible for one man to include in his discussion all types of differentiated cells.

There are different kinds of germ cells, and hundreds of varieties of somatic cells in both the kingdoms. It may be said without any fear of contradiction that the cytoplasm of a young undifferentiated cell, be it a plant or an animal cell, is a polyphasic colloidal system in which the suspended particles are too small to be seen under an ordinary microscope. But gradually as the cell grows and the physiological processes of differentiation set in, there appear different kinds of cytoplasmic 'inclusions', which are the visible expressions of those processes—the physiological processes themselves being entirely beyond our ken.

There is a vast and bewildering array of these 'inclusions', which appear in the cell during physiological differentiations. These may be roughly placed into two categories—the protoplasmic and metaplasmic, although it is impossible to draw a sharp line of demarcation between them. The Golgi bodies, the mitochondria, the centrosomal system, the plastids of plant cell, and at least a part of the achromatic spindles of dividing cells may be cited as examples of active cytoplasmic 'inclusions', which are capable of growth and self-perpetuation. The secretory granules of gland cells, the Nissl granules of nerve cells, the protein and the fatty yolk of ova, the nucleolar extrusions of certain ova, and the starch and aleurone grains etc., of plant cells are examples of dead, inert, metaplasmic material.

In this paper the author deals with those physiological differentiations in the cytoplasm of the growing animal germ-cells, which are partly reflected by changes in the morphology, chemistry and physical state of the mitochondria, the Golgi bodies, the centrosomal apparatus, the achromatic astral system, and the nucleolar extrusions.

Recently the nucleic acids of the cell, both DNA and RNA, have received a good deal of attention at the hands of biochemists; and I believe Dr. B. R. Seshachar will enlighten us with regard to the existence of these acids in the cytoplasm and their connection with the formation of cell proteins.

2. DR. H. N. RAY (Calcutta) : *Some observations on the cytochemical pattern of certain parasitic Protozoa.*

In recent years our conception about the cell as a functional unit has undergone many changes. According to the modern conception every cell is visualised to have, besides its specific morphological identity, a normal cytochemical pattern of its own which is responsible for its very existence, reproduction etc. The cytochemical pattern of *Entamoeba histolytica*, *Trypanosoma evansi* and *Eimeria tenella* will briefly be discussed here while my colleague Dr. P. C. Sen Gupta will deal separately with *Leishmania donovani*, *Plasmodium berghei* and *Balantidium coli*.

Entamoeba histolytica :—

The chromatoid bodies contained both RNA and DNA and gave positive reaction for alkaline phosphatase as well as for acid phosphatase. These bodies were found to take part in the formation of the inner membrane of the cyst-wall. Alkaline phosphatase was also present in the nuclear chromatin and karyosome and also exhibited a bilaminar reaction at the surface layer of the cell-body. Glycogen was present in both cystic and the trophic forms. Mitochondria were found to be intimately connected with the oxidation-reduction phenomenon.

Trypanosoma evansi :—

After treatment with antrycide (a trypanocidal drug) a sharp rise of acid phosphatase activity in the nuclear membrane and the cytoplasm was noted, while a general decrease of alkaline phosphatase activity was evident in the nuclear membrane, karyosome, kinetoplast and all along the length of the flagellum. A considerable increase of reserve mucopolysaccharide in the cytoplasm was also apparent in the treated organisms. The above changes suggested an attempt on the part of the organism to offset the action of the drug. No such change was noticed in trypanosomes obtained from splenectomised rats in which the infection could not effectively be controlled with antrycide.

Eimeria tenella :—

The gradient of reaction for the RNA and for alkaline phosphatase was found to be directly proportional to each other and to the tempo of the physiological activity of the parasite, the reaction being more intense when the rate of multiplication was high and the rate of protein synthesis, presumably, also very high, and *vice versa*. This suggested that RNA along with alkaline phosphatase was connected with protein synthesis.

Occurrence of alkaline phosphatase in the Golgi region of the second generation merozoites suggested a functional relation between the two. Golgi complex appeared to secrete the alkaline phosphatase for the purpose of synthesis taking place at this site.

The association of alkaline phosphatase and the hyaluronic acid type of polysaccharide (HAP) in the nuclei of all endogenous stages, peripheral globules of macrogametocytes and in the oocystic membrane suggested possible correlation between alkaline phosphatase and the synthesis of HAP.

Mucopolysaccharide occurred in the cytoplasm only and by dint of its hydrophilic character was found to be of value to the parasite in its various stages of the life-history. Highest concentration of mucopolysaccharides was attained in the second generation schizogony, a stage at which the parasites attained immunogenic character.

5-nucleotidase occurred in the karyosome and was perhaps concerned with the metabolism of protein.

DNA occurred in low polymerised form in the asexual generation of the parasite, while highly polymerised DNA occurred in the nucleus of the macrogametocytes and the male gametes. Oocyst nucleus was devoid of DNA, though about 12% of them had DNA in the cytoplasm. *De novo* synthesis of DNA during sporulation is suggested, as the nuclei of the sporozoites contained abundant DNA.

3. DR. SIVATOSH MOOKERJEE (Calcutta) : *Nuclear-Cytoplasm Dependency in Radiated Cells.*

Structural alteration of an enzyme, in the form of its disappearance and re-appearance, in a cell is indicative of a nuclear—cytoplasm dependency. Active trophic forms of amoebae were radiated by million-volt X-ray generator at 600r within half-hour of radiation, loosening the alkaline phosphatase reactions in their cytoplasm. The nucleus gives a strong enzyme reaction. However, the enzymatic reaction of the nucleus becomes progressively lowered in next two to three hours of radiation. Such radiated amoebae are capable of living a physiologically sub-normal life only for a short period. Within five hours, the enzymatic activity of nucleus visibly revives into its fold. The cytoplasm can only attain its alkaline phosphatase reactivity at a later period when the nucleus has fully regained its normal reaction (Mookerjee and Hajra). Results on radiated cells of human cervix cancer (Mookerjee and De) and on chick embryos (Mookerjee and Bose) give a similar evidence of an initial cytoplasmic denaturation of alkaline phosphatase followed by a subsequent nuclear disintegration.

The timely behaviour of the appearance and disappearance of alkaline phosphatase in amoeba gives a scope to argue that, (1) the cytoplasmic phosphatase is more fragile to radiation in losing its reactions but the nuclear phosphatase is more sturdy because it is affected after the cytoplasm; (2) during the physiological substance-regulation the nucleus seems to play a major rôle, *a priori* appearance of alkaline phosphatase is necessary in it for a later reappearance of the cytoplasmic alkaline phosphatase.

4. DR. AMIYA B. KAR (Lucknow) : *Crook's change in the cytoplasm of basophil cells of the pars intermedia after ACTH treatment and its physiological significance.*

Crook's change refers to an aggregation of basophilic granules of the pituitary basophils at certain location(s) and the hyalinization of the rest of the cytoplasm. This change, however, does not signify any degenerative condition, but on the contrary, is an expression of altered physiological state of these cells. In connection with our studies on the identity of ACTH we observed that prolonged administration of this hormone to kittens causes pronounced hypertrophy of the basophils of the pars intermedia and an aggregation of basophilic granules in a perinuclear manner indicative of Crook's change. These phenomena undoubtedly indicate an enhanced secretory activity of the basophils and as these are solely responsible for the elaboration of intermedia in kittens, it is logical to interpret that ACTH stimulates the output of intermedin. Besides, acceleration of cytoplasmic alkaline phosphatase activities in the basophils after ACTH treatment or increase in intermedin contents as shown by actual assay of pituitaries provides evidences which also point towards an enhanced production of intermedin.

These findings suggest that (1) ACTH can influence pigmentation only in an indirect manner through a stimulation of intermedin production but it has no direct pigmentogenic property, and (2) the appearance of pigmentation on the body in certain diseases characterized by an excessive output of pituitary ACTH (Addison's disease, Cushing's syndrome, some acute stress conditions) may be ascribed to a stimulation of intermedin production by the trophic hormone.

5. DR. P. C. SEN GUPTA (Calcutta) : *Cytochemical observations on certain parasitic Protozoa, viz., Plasmodium, Leishmania and Balantidium.*

Mitochondria and Golgi complex

These structures can be demonstrated in the cytoplasm of the plasmodia studied viz., *P. berghei* and *P. vivax*, and in leishmanial flagellate and *B. coli*, by appropriate supravital staining techniques. The shape and size of the mitochondria vary from minute grains in the plasmodia, to small dot or rod-shaped structures respectively in the leptomonads of *L. donovani* and *B. coli*. These structures show some movement along the cytoplasmic current in the *Balantidium* and slight movement in the other two. Evidence of active oxidation-reduction phenomenon is noted in the plasmodia but not in the other two parasites. Golgi complex is present in the form of minute to relatively larger spheroids in these three Protozoa, the size varying with that of the organism.

Nucleic acids.

The chromatin of the plasmodia contains a minute amount of DNA, and RNA is also one of its constituents. The cytoplasm is very rich in RNA. The nucleus and the kinetoplast of the leishmania and the leptomonad forms of *L. donovani* contain DNA, and the cytoplasm stains light with pyronin. In the *Balantidium*, both the macro- and the micronucleus contain DNA and the basal granules of the cilia are also Feulgen-positive. The cytoplasm stains lightly with pyronin. RNA enters into the composition of the nuclei of both *L. donovani* and *B. coli*. Cysts of *B. coli* show intense reaction for RNA, in the cytoplasm.

Polysaccharides.

Polysaccharides cannot be demonstrated with certainty in the plasmodia and *Leishmania donovani*; but the cytoplasm of *B. coli* contains a large amount of polysaccharides most of which is glycogen; the cysts show more intense reaction.

Alkaline phosphatase.

Alkaline phosphatase is present mainly in nucleus of all the three classes of Protozoa, viz. Sporozoa, Mastigophora and Ciliata, but the cytoplasm shows diffuse and weak reaction in all cases; the border of the parasites showing somewhat more marked reaction than the rest of the cytoplasm. The following cytoplasmic structures show the presence of the enzyme : kinetoplast of *L. donovani*, basal granules of the cilia of *B. coli* and the walls of the cytophyge.

In addition, a number of cytoplasmic granules of *L. donovani* (leptomonad form) shows the presence of alkaline phosphatase.

It has been found that the intensity of reaction was much less in balantidia obtained from cultures in Dobell's medium than in those in faecal smears, though the distribution of the enzyme was identical.

Comments.

Mitochondria are believed to contain proteins, glutathione, lipids, enzymes and vitamins, and are regarded as store of metabolic material, as concerned with digestive process and with respiration. It is probable that active oxidation-reduction phenomena noted in the plasmodia indicate active metabolic processes being

in progress. Absence of such rapid changes in colour of janus green in the other two Protozoa is probably due to different functional activity of these intracellular structures.

The golgi complex is probably mainly concerned in protecting the cell from noxious agents which are absorbed in these structures.

As for the nucleic acid, it is a peculiar feature noted in our study of parasitic Protozoa belonging to different classes, that the Rhizopoda and Sporozoa studied so far, which are lower in the scale of evolution, appear to be relatively rich in RNA and 'makes do' with a minute amount of DNA. The Mastigophora has relatively larger amount of DNA and the even more complex protozoon *B. coli* has a large amount of DNA in its nuclei. More complex the organism more is its DNA content. Also DNA is present in organelles other than the nucleus, viz., kinetoplast, the basal granules.

It appears that the plasmodia and *L. donovani* do not ingest or store polysaccharides; glucose is obviously utilised as such. The ciliate on the other hand ingests and stores polysaccharides which it breaks down probably into monosaccharides in the course of metabolism.

Encystation of *B. coli* is associated with storing up of relatively large amounts of polysaccharides and the RNA content is distinctly more than that seen in the trophic form. Encystment being only a protecting device and not concerned with multiplication, it is curious to note the 'laying up a store' of food and essential nucleic acids by the ciliate. Even the enzymes necessary for the utilisation of this store are present in abundance.

It is generally held that plasmodia and *Leishmania* absorbed their nutriment by osmotic process. But the presence of a layer of phosphatase in the peripheral margin of these Protozoa seems to show that transfer of metabolites in and out of the body of the animals is by enzyme activity. In the ciliate more complex food is ingested and digested in the cytoplasm and the cytophyge which is an excretory organ has considerable amount of alkaline phosphatase in its wall; the functions of the enzyme may well be similar to those of the epithelium of the large intestine of man. Small amounts of cytoplasmic alkaline phosphatase present in the plasmodia and the *Leishmania* are apparently concerned with the metabolic activity of the Protozoa and those in the *Balantidium* with digestion and metabolism. Low alkaline phosphatase content of balantidia obtained from culture in artificial media is possibly due to soluble and simpler food being made available in the medium, metabolism of which does not require such amounts of the enzyme as in the natural habitat in the bowel.

6. DR. P. N. GANAPATI (Waltair) : *Polysaccharide cycle in the cytoplasm of Gregarine.*

Discussed the polysaccharide cycle in the gregarine (Sporozoa-Protozoa) *Grebneckiella pixellae* parasitic in the intestine of the Centipede *Scolopendra morsitans*. The polysaccharide is paraglycogen occurring as discrete bodies scattered in the cytoplasm. These bodies are more concentrated in the dentomerite than in the protomerite. These bodies accumulate at the centrifugal pole when the organisms are subjected to centrifugation at high speeds. In the sporonts there is a difference in the paraglycogen content in the two sexes, the females having more than the males. The paraglycogen could be located only in the female gametes as a few spherical bodies while in the male it could not be traced. In the sporoblasts also these bodies have been observed and they are more in number than in the gamete.

7. DR. A. GOPALAKRISHNA (Pilani) : *Cytoplasm in the elaboration of male hormones in Scotophilus.*

In *Scotophilus wroughtoni* (Thomas) (microchiroptera vespertilionidae) there is a marked increase in the number and size of the leydig cells of the testis during

the breeding season. No mitotic activity was noticed in these cells and hence the variations can only be explained by the assumption that the intertubular connecting tissue cells get transformed into interstitial cells expressly for the purpose of elaboration of the male hormones. Obviously this indicates that the structure responsible for this change, and therefore for the hormone metabolism of the testis, is primarily the cytoplasm. This is further borne out by the cytochemical analysis of the testis during the different seasons of the year.

8. SRI S. R. U. RAO (Pilani) : *Behaviour of mitochondria in Scorpions.*

The mitochondria do not arise "de novo" as it was assumed. It has been shown that there are still smaller bodies in the cytoplasm known as microsomes (thanks to the discovery of Claude) which get themselves converted into mitochondria. Our idea of the "de novo" origin is more due to our not finding better methods, I mean for want of the recent modern techniques, to search for such smaller bodies which are responsible for the origin of mitochondria. Another idea which relates to the importance of mitochondria (whose importance is very much lessened if we assume the de novo origin of mitochondria) is that in some scorpions during spermatogenetic divisions the mitochondria behave almost, if not exactly, like the chromosomes, particularly with reference to their distribution during the two divisions.

9. DR. S. M. DAS (Lucknow) : *Contractile Vacuole formation in Amoeba.*

The story of the formation of contractile vacuoles in *Amoeba* is far from complete. That there may be one or more contractile vacuoles in any one given species is known. But how do they first arise? What is the structural physiology of the contractile vacuole? In one species of *Amoeba* (*A. verrucosa*), we have observed that besides the golgi bodies reported by Brown around the newly formed vacuoles, mitochondria concentrate in the particular region of the cytoplasm and show great activity. The mitochondria appear to enter the golgi region after being elaborated in the cytoplasm adjacent to that region. The secretion droplets are formed within the golgi spots. The first stage appears as scattered granules, the second as C-shaped agglomerated granules, and the last and third stage may be defined as the ring stage with the small formative vacuole lying inside each ring thus formed.

That mitochondria represent elaborated products which are employed as sources of matter and energy in cell activity is well known. Dr. Sen Gupta in his discussion suggested that mitochondria have two functions in cell activity : firstly in the digestive process and secondly respiratory. Our studies show that a third function viz secretion in the formation of vacuoles in *Amoeba* may be added. The golgi bodies give rise to secretion droplets and presumably one of the materials for the synthesis is furnished by mitochondria. The girdle disappears after the formation of each drop in the cytoplasm. These watery drops coalesce, form larger vacuoles, and finally by osmoregulatory activity the vacuole expands and throws its products outside the cell.

XVIII. MECHANISM OF GASTRULATION.

Chairman : DR. P. SEN (Calcutta).

1. PROF. M. A. MOGHE (Pilani) :

All embryological work till the investigations of Roux and Driesch was purely morphological and too much emphasis was laid on the germ layer theory and its assumed phylogenetic significance. In 1883, Roux enunciated the view that development proceeded by mosaic-like distribution of potencies. Driesch's announce-

ment that he obtained an entire larva from an isolated blastomere of sea-urchin seemed to negative Roux's theory. But subsequent research on differentiation of poplasmic material and its distribution to blastomeres during cleavage brought out the concept of 'time element' up to which the potencies may or may not be similar. The brilliant work of Spemann and his discovery of the organiser, Conklin's work on cell-lineage and Born's transplantation methods have contributed to the modern concepts of gastrulation.

Modern concepts deal with the mosaic theory of development, the distinction between the mosaic and the regulative eggs, determination and the nature of chemical processes during gastrulation.

Spemann found that up to a certain stage in gastrulation the fate of most of the embryonic regions is not irrevocably determined. One region of the amphibian embryo is, however, less plastic. It contains within it the influence which determines the fate of the regions with which it comes in contact. Roux made further distinction between dependant differentiation and self differentiation. By 1909 the concept of determination by morphogenetic stimuli was well known. Spemann further distinguished between primary and secondary organisers. The state of the reacting tissue is as important as the tissue itself.

Induction usually occurs as a reaction between three factors: the graft, the overlying tissue of the host and the organising centre of the host. In induction, we are confronted with two determinations: that of presence and that of character. The term evocation was suggested for the first type and the term individuation for the second.

It was found that ooplasmic material shows differential susceptibilities to poisons. This selective sensitivity suggests the region of highest metabolic activity. In 1928, Child attempted to include organiser concept in his theory of physiological gradients. The organiser has an increased susceptibility to a number of chemical substances. There is also a thermal gradient.

The animal-vegetal gradient was established for distribution of glycogen, lipids, proteins, and the SH groups associated with proteins. During gastrulation a new centre of synthesis of ribo-nucleoproteins makes its appearance. The localisation of alkaline phosphatase throws considerable light on the problem of primary morphogenesis. Other chemical studies relate to the elimination of carbon-dioxide by isolated organizer, oxygen consumption and the measurement of respiratory quotient.

2. DR. A. GOPALAKRISHNA (Pilani): *Gastrulation in Mammals.*

The definition of the word 'Gastrulation' is derived mostly from the study of the early embryology of invertebrates and lower vertebrates. The classical definition laid stress on the conversion of the unilaminar blastula into a bilaminar condition resulting in the establishment of the endoderm and incidentally the formation of the archenteron. But recent experimental work on the lower vertebrates have revealed that the central point of interest in gastrulation is the formative movements of cells culminating in the laying down of germinal layers. In either case the result of gastrulation is the formation of the archenteron and the endoderm.

On the basis of these definitions the analysis of the gastrulation in mammals is rendered complicated because the conversion of the blastula into a bilaminar gastrula with the establishment of archenteron is apparently quite unconnected with the formative movements of cells resulting in the establishment of the germ layers of the embryo. This is because in mammalian development extra-embryonic structures are laid down much earlier than the embryonic structures, so that even before the primordial structures of the foetus are differentiated the embryo has all the essential germ layers and archenteron. The formative movements resulting in the orientation of the germ layers are delayed till after the formation of the amnion.

We are, therefore, confronted with the problem of establishing the homologies and analogies of the different processes in the mammalian development with those of lower animals—particularly the anamniotes. At best gastrulation in mammals may be considered as consisting of two apparently disconnected phenomena—the formation of the endoderm and archenteron, and the formative movements resulting in the establishment of the blastopore and embryonic germ layers in their definitive dispositions.

A clearer understanding of the process in mammals will throw light on one of the most fundamental problems in mammalian development—the homologies of the extra-embryonic structures such as the yolk-sac, the amnion and the allantois. That the mammalian yolk-sac is homologous to the archenteron of lower animals is substantiated by the fact that during early developmental history the yolk-sac is the main structure concerned with the nutrition of the embryo. Recent findings in some species of chiroptera, in which, during development the yolk-sac undergoes changes in its histology to get converted into a gland-like structure recall to our mind the potency of the gut endoderm to give rise to glands during ontogeny. Very little can be said regarding the homologies of the amnion and the allantois. Until their homologies are thoroughly established they can at best be considered as ontogenic adaptations of the amniotes in general and of mammals with special reference to the allantois.

3. DR. S. MOOKERJEE (Calcutta) : *The importance of the morphogenetic movements in the mechanics of gastrulation.*

The transformation of an embryo from its blastula to gastrula condition is mainly possible through the trans-location of the cells. The morphogenetic movements of the embryonic cells carry them from one to the other region of the embryo—a necessary precondition for the tissue-differentiation. A discussion will be posed here to show the eventful part of cell movements in the mechanics of gastrulation.

At the time of amphibian gastrulation, when cells are invaginating through the dorsal lip of the blastopore, we have placed the lateral plate mesoderm cells in place of the organiser and *vice versa* (Mookerjee 1953). Under the new contingency, the morphogenetic movements of the cells occurred and the lateral plate mesoderm differentiated into notochord and a feeble induction resulted.

The morphogenetic movements in a chick blastoderm are very sensitive to X-rays. Our studies (Mookerjee and Bose, 1953, and Bose and Mookerjee, 1954) have shown that high dosages of X-rays (over 600r) may interfere with the process of cell movements; consequently there may be failure of primary and secondary inductions and causation of defects in the individuation.

Individual cells of embryos, when performing specific morphogenetic movements, have been isolated, and experimental morphodynamics were initiated to them by mild hydrolysis in a sublethal dose (Mookerjee 1952). Mookerjee, Denchar and Waddington (1953) have isolated a moiety of cells undergoing a particular type of histological differentiation and tested the intracellular morphogenetic forces operative between them.

One of the major issues of gastrulation problems focuses round the problem of specific types of morphogenetic movements of embryonic cells which set the stage for the evocator-competence reactions. We are so far almost ignorant of the inherent factors responsible for bringing about the cell movements inside the embryo, their interactions and final differentiation into a structural pattern.

4. DR. SHYAMA CHARAN (Gwalior) :

A. Information regarding the formation of the blastocoel cavity in Herpests : In this animal a blastocoel cavity is noticeable even in the 5-celled stage.

B. Information regarding Rhinopoma :

- (i) Endoderm is formed out of the embryonal mass as a result of delamination. This layer grows all round and underlies the trophoblast.
- (ii) The trophoblast does not disappear in Rhinopoma as it does in some other forms as stated by Gopal Krishna.

5. SRI VINODKANT CHUNILAL SHAM (Baroda) :

Apart from certain specific histochemical work, it is a modern trait to study the appearances which the eggs present after staining by vital dyes. There has been a tendency to interpret the effects as due to differences of pH inside the cells. This suggests that differences do exist between the cytoplasm of these regions. Hence differentiation of pH in different regions of egg and also that of different types of eggs, have important significance in the mechanism of gastrulation.

Section of Anthropology and Archaeology.

NIX. TRIBAL WELFARE AND REHABILITATION.

Chairman : DR. B. K. CHATTERJEE.

1. DR. NABENDU DATTA-MAJUMDER : Tribal Welfare and Rehabilitation.

The total number of Scheduled Tribes in India is 212 having a total population of 19,111,498. That is, the Scheduled Tribes form 5.36% of the entire population of India. The tribal peoples belong to different ethnic and cultural types. They live in various economic stages ranging from hunting and food gathering through shifting and terraced cultivation to plough cultivation in the plains. The extent of their contact with non-tribal peoples has also a wide range of variation resulting in different degrees of acculturation.

The problem of tribal welfare and rehabilitation is intimately linked up with the question of what should be the place of the tribal peoples in the national democratic set-up of India. After discussing the different schools of thought on the latter question the writer of this paper holds the view that the solution lies in the integration (as distinct from either isolation or complete assimilation) of the tribal peoples in Indian society. This integration is quite compatible with heterogeneity of cultures. The different component groups in such an integrated socio-economic-political set-up while maintaining their social distinctiveness and traditional background will acquire certain common denominators of Indian national culture valued by all and thereby develop a sense of national unity.

The measures necessary for tribal welfare and rehabilitation are bound to vary with the stages of socio-cultural development of the different tribal groups. The hunting and food-gathering Birhor, Koria and Hill Maria cannot be subjected to the same treatment as the Juang, Pauri Bhuiyan and Kandh shifting cultivators or the Munda, Oraon and Santal plough cultivators in the plains. The transition of the tribal peoples from their tribal economy to our national economy must be planned and piloted in conformity with the cultural matrix of the social groups concerned. In other words, the desired integration of the tribal groups in the national democratic set-up of India has to be brought about without suddenly uprooting them from their traditional cultural mooring and thereby causing them irreparable physical and psychological damage.

2. DR. J. D. N. VERSLUYS : Tribal Welfare and Research.

At the two Conferences held at New Delhi in June, 1952 and Lohardaga in November, 1953 the need for research in connection with tribal welfare was stressed.

In some States research centres have been set up or are in preparation, but one does not gain the impression that research is actually considered to be an essential factor in tribal welfare work. The term welfare work should be taken in its widest sense as to include measures against soil erosion, or to promote acculturation, or improved agriculture, or better health, etc. It may be useful to make it clear that the research to be carried out should be immediately connected with the specific kind of welfare work envisaged in a particular area and not take the character of general research into all the aspects of tribal life which would require more time and personnel. This "directed" research should of course make full use of existing knowledge available with officers of various Government Services and non-officials or in existing reports. However, it will be necessary to investigate how far all this is still applicable as important changes may have occurred meanwhile, and particular attention should be paid to local differences which may occur in the same tribe even within relatively small areas. Non-tribal as well as tribal groups of the population may have to be included in the survey.

3. SRI A. BHATTACHARYYA (In Absentia) :

Without proper understanding of the sentiment and cultural background of a people any work undertaken in the name of 'welfare' among them naturally leads to disastrous results. Moreover no programme even on a regional basis, not to speak of all India, can be adopted for tribal welfare. For though due to various circumstances various Indian tribes have concentrated themselves on certain difficult parts of the sub-continent, yet it is not a fact that they have been able to develop social and cultural integrity in each and every area inhabited by them—they live as neighbours and though economically they share the same fate, yet each of them retain its own characteristics, social, cultural and linguistic. The historical background of the development of socio-cultural life of each tribe is also different. The example of Chota Nagpur Division of Bihar can be cited. The aboriginals living over this area are divided linguistically by two broad divisions—one Austro-Asiatic and another Dravidian. Culturally also there are two broad sections—firstly, the food-gathering and, secondly, the food-producing. There are many villages here where both these different groups of people live together as neighbours outwardly sharing a common economic life but inwardly retaining their cultural individuality. A common set of 'welfare' plan have been imposed upon the people. Basic schools have been started with a common curriculum and a common medium of instruction which is Hindi, a language unknown over this area. Oraon which is a well-developed language finds no place among the Oraon children. Munda an equally important tribal language shares the same fate with the Munda-speaking children. This has resulted in little progress in real education of these peoples so far.

As far as rehabilitation is concerned that the nomadic tribes cannot be rehabilitated in agriculture is well-illustrated by the Birjias of this area.

4. DR. P. N. SEN GUPTA (Calcutta) : *Importance of Dietary and Nutritional Assessments in the Welfare Programmes of the Tribes.*

Before any tribal welfare scheme can be rationally and successfully undertaken one of the most important things to be considered is with regard to their nutrition and health. It is to be understood whether foods are sufficient for maintenance, whether these provide with adequate nutrition, whether the tribes are growing or heading towards extinction, how the deficiency diseases like goiter can be prevented and in what possible ways the dietaries can be improved. Some tribes are living on wild products, some are herbivorous, some are carnivorous and some are lacto-vegetarians. The effects of these different dietary ranges on the growth, physique and health of the tribes can be judged only by proper and extensive scientific assessments.

It is revealed from the nutritional investigations carried out among the Abors, Nocte Nagas and tribes of Tripura State and Travancore that the dietary patterns and their nutritional value and growth of children of two tribes are much better than those of the other two. The cause of this difference has been explained. The possible reasons of the incidence of goiter in one tribe and how it can be prevented has been discussed. Suggestions have been put forward how the dietaries of the tribes can be improved under the existing conditions for better nutrition and better health.

5. SRI AMBALAL VYAS (Bhubaneswar) (In Absentia) : *Tribal Welfare and Rehabilitation in Orissa.*

1. There is a special Department for Tribal and Rural Welfare in Orissa to ameliorate the condition of the tribals in the following fourfold way.

(a) Facilities for Education; starting of residential Ashram Schools, day-schools, training centres for teachers and workers; giving scholarships, stipends and lump sum grants for higher education, etc.

(b) Medical and health programme. Drinking water wells, distribution of medicines, propaganda for cleanliness, etc.

(c) Removal of Social disabilities. By legislation and by propaganda.

(d) Economic betterment. Priority in giving cultivable waste lands, free distribution of bullocks, ploughs, etc., starting forest settlements, preventing exploitation by legislation and by starting multipurpose Co-operative societies, etc.

2. There are different categories of tribals in the state. They are at various stages of civilization.

(a) Settled agriculturists doing even wet cultivation and raising cash crops like turmeric, ginger, tobacco, etc.

(b) Doing mixed cultivation, partly settled and partly shifting.

(c) Living partly on shifting cultivation and partly on selling forest produce such as gum, lac, tamarind, kendu leaves for Bidis, honey, grass and hunting, etc.

(d) Daily labourers :—Field labour, Mine labour, Tea labour, working as agricultural servants or Domestic servants, looking after cattle, goats, pigs, poultry, etc., looking after mango orchards, pack-fruit trees, etc.

3. Rehabilitation : for whom, why and how of it. Resources; Agency; machinery, approach, etc.

4. A. Evil effects of shifting or axe-cultivation.

(a) Wreckless destruction of valuable timber.

(b) Soil erosion.

(c) Adverse effect on the fertility of the soil.

(d) Floods causing damage to crops, property and spreading sands over fertile lands.

(e) Decrease in rainfall.

B. Where shifting cultivation is unavoidable what precautions should be taken to minimise the evil effects protecting the hill tops and ridges; terracing the lower slopes, etc.

5. Tribals' view point in favour of shifting cultivation. It is a way of life with many. Protection of crops from wild animals; less labour; no further manuring necessary, etc.

6. Orissa Government's forest settlement schemes. Number of families rehabilitated. Acres of land reclaimed. Money spent per family. Do the tribals appreciate Government measures? Defects and drawbacks.

7. How to make rehabilitation schemes successful and popular.

8. How to stop the exploitation of the tribals by money lenders, contractors, land-holders and petty Government servants of the forest, police, Excise and Revenue Departments.

9. Right type of education of the children, social and adult education, visual propaganda, etc.

6. SRI N. DAS (Ranchi) (In Absentia) :

Rehabilitation of the tribes who are at the collectional stage of economy has drawn considerable attention from the anthropologists and administrators. Particularly the tribes who resort to the shifting cultivation and thereby destroy the forests are being widely discussed. Destruction of forests lead to decrease in the rain-fall and soil-erosion. The Hill Kharias and the Pahariyas in the State of Bihar are such tribes. The Government of Bihar are spending nearly Rs. 50,000/- annually for the rehabilitation of 100 Kharia families in a prepared land in Dhalbhum. The Pahariya rehabilitation scheme costs lakhs of rupees.

2. Welfare measures in their practical application by far the most manifested in these rehabilitation schemes. Nevertheless scientific studies of these tribes had not so far been undertaken, thereby leading to lacunae and some times frustration among the inmates of those colonies. Cultural anthropologists can be of immense help to the administration. Fortunately the Government of Bihar have established a Tribal Research Institute with its permanent headquarters at Ranchi to study the tribal cultures in scientific lines, and on the basis of them to suggest appropriate welfare measures.

3. One important thing the Anthropologist had been so far missing as example, i.e., the ideas and experiences of ranked administrators. Hence it is essential that all out efforts can now be made to analyse their views.

4. Simultaneously the anthropologists can assist the administration in several ways except their own specific studies thereby they will no more make them curio-hunters, but men of practical approaches.

5. Academic deliberations in the Universities serve their own purposes but they some times do not fit in to the realities. This difference need be hammered out.

6. But appropriate welfare and rehabilitation will not be possible without a thorough study of the cultures of the people concerned by anthropologists who in their return can marshal cooperation from other sister social sciences.

7. SRI N. K. SYAMCHAUDHURY (In Absentia) :

The need of better deals for India's widely distributed tribes stands as mighty challenge to the Indian Anthropologists. In view of the country's National Planings a systematic and scientific approach to the nature of the problems should be attempted. Tribal communities should not lag behind in mal-adjusted conditions as social and economic well-spots in the national life.

Hitherto secluded tribal areas will open up as mineral and other resources are tapped with the expanding facilities of the reconstruction projects. But due to cultural and social differences vis-a-vis the local ecological factors there will be variations in the nature of the problems. This factor is of prime importance for to work amongst tribes the anthropologist should not think himself a branded social worker with pocketful of money who tries to improve the lot of some unfortunate human burdens by providing some facilities. Missionary zeal is necessary, not attitude.

Considering the ethnographic past and the present of a particular tribal community in question ways and means for welfare and rehabilitation could be scientifically predicted. The present requirement is (1) to gather objective data and (2) their systematization into ethnographical-cum-ecological areas thereby obtaining the nature and measure of problems. Research planning is necessary.

8. DR. B. H. MEHTA (Bombay) (In Absentia) : *Rehabilitation of Ex-criminal Groups.*

The problem of the ex-criminal tribes is one of the most difficult problems confronting India after Independence.

Need of a scientific approach to guide the proper understanding and treatment of the problems. Present day tendency of a universal approach to entirely different kinds of problems.

The true implications and content of a rehabilitation programme as the primary objective of treatment of ex-criminal tribes.

The historical background and lack of data to reveal who were the ex-criminal tribes. Several possible theories to explain who they are, and how they came to be considered criminals. They are not tribes; but only gangs, groups, small communities, or maladjusted sections of major tribes.

Causes of maladjustment : Individual factors, lack of adjustments to habitat, difficulties of economic life, inability or unwillingness to adjust to law and order of the State, feudal concepts of property, land and forest policies of British Government, conflict with caste system, etc.

Historical evaluation of British approach to the problem, and consequent protection and preventive measures, social legislation, and programmes of adjustment. State comments on social legislation, methods of registration, identification, restriction, and segregation. The failure of British objectives and methods. Causes and consequences of failures; social maladjustments of the ex-criminal tribes aggravated.

The problem of ex-criminal as a heritage of British rule to Free India. Neglect of these communities in the Constitution, and absence of suitable State agency to deal with the problem.

The 1952 legislative measures do not solve the problem; but are only a beginning of solution. Lack of preparation and planning to deal with the subject after legislation.

Suggested methods of rehabilitation and the need for research, experiments, and evaluation of results of prejudices.

Method 1. Rehabilitation on land in selected areas acceptable to them. Importance of allowing a gradual process of acculturation and assimilation.

Method 2. Rehabilitation of small groups, instead of the whole community in areas suitable to them in terms of economic potentialities.

Method 3. Intensive programmes of vocational training for youths.

Method 4. Partial segregation of children, organising an intensive educational programme from 4 to 21 years.

Method 5. Intensive application of community organisation programmes to manageable communities; communities of between 250 to 1000 families. This method will involve :

(a) Development of physical area and treatment of the housing problem;

(b) Programmes of economic development on a planned basis, preferably on a cooperative basis.

(c) Provision of adequate social services for health, education, community recreation, and woman and child welfare.

(d) Intensive treatment of social problem found within the community group.

(e) Gradual development of leadership from within the community and developing programmes of intensive social participation to prevent individual maladjustments and delinquencies of age groups of both sexes.

(f) Intensive case work for maladjusted individuals.

9. SRI SUNARAM SOREN (Orissa) :

In Orissa there is a large tribal population. It is noticed that they are in three stages of development. The first are those who are living mixed up with

the non-tribal population in an advanced stage of acculturation. The second category consists of those who live in the hill districts, namely, the ex-State areas and the old districts of Ganjam and Koraput. They are poorer and less advanced than the first category. In the third category may be placed those tribal who have their abode on hill tops and in the midst of thick jungles. They are living a primitive life in a most backward condition socially, educationally and economically.

It is the third category of the tribals for whom development work has to be planned very carefully. It is here that help of the anthropologist is necessary for a scientific study of their present condition, their customs and beliefs, to make proper planning for their amelioration. For, a welfare State cannot allow things to develop themselves, effort has to be made to help these people to come up to the level of the average citizen.

It has to be studied how the process of acculturation has grown in respect of the other two classes of tribes mentioned above; it has to be studied in what way efforts made in the past have affected their lives. These facts will help in arriving at some conclusions about the policy to be followed for assisting the third or the most backward category of the tribes in the State. These tribals are addicted to shifting cultivation. The present policy is to bring them down to the plains for settled cultivation. These colonies have yet to be popular. But experience has shown that once a scheme is found suitable to the tribal, he eagerly comes to cooperate in its execution. Our educational scheme (Ashram and Sevashram) may be cited as an example. The Adibasi was presented with a scheme that he liked. Another instance is the use of modern medicines. The Adibasi is still preferring the primitive methods of treatment.

The Government of Orissa have luckily got the suggestions of eminent social workers like the late Shri Thakkar Bapa. They have set up a Tribal Research Bureau with two Research Scholars to assist them to collect information to help them in the solution of these and similar problems.

Section of Agricultural Sciences.

Jointly with the Section of Geology and Geography.

XX. MINERALS IN SOILS AND CLAYS.

(Chairman : DR. R. J. KALAMKAR (Nagpur).)

1. DR. B. CHATTERJEE (Silpur, Calcutta) opened the discussion and read his paper on the *Cation Dissociation of Clay Minerals* :

The essential inorganic part of a soil is the clay material which is composed of one or more of secondary silicate minerals known as 'Clay Minerals'. The common type of clay minerals present in soils are kaolinite, montmorillonite and illite. The clay minerals differ in their capacities for fixation and release of cations. A knowledge of the fractions of cations dissociated from clays is of utmost importance to agronomists as this will supply them information on the ionic environment in which the plant root is growing and will thus help them in drawing up fertilization and liming projects. Development of membrane electrodes has made possible studies of the ionization of cations from clays. The cation activity in clay systems has been found to depend on the type and concentration of clay minerals and also on the nature of cations concerned. The degree of dissociation of the divalent cations is much less than that of the monovalent ones. The ionization of the monovalent cations (Na, K, NH₄) from clay minerals follows the order : Kaolinite>Montmorillonite>Illite but for divalent cations the general order at pH values less than 6.0 is Illite>Montmorillonite>Kaolinite (except that kaolinite is most ionized with barium)

white at complete neutralization the ionization of the divalent cations follows the order : Kaolinite>Illite>Montmorillonite. It has been found that the activity of the cations does not increase appreciably on the addition of the corresponding base to the clays over the range of about 20 to 80 per cent neutralization (Base saturation) and as a result the active fraction shows a marked decrease over this range. This observation is very significant in relation to fertilization practices in that if the fertilizer material be inadequate for the entire area it will be wise to spread it over a relatively small area than to apply it in insufficient quantity over the entire field.

2. DR. S. P. RAYCHAUDURI and SRI C. N. RAO (New Delhi) :

There are many mineral fertilisers in India which require to be properly exploited for increasing the crop production. Deposits of nitre earth provide the major nutrient nitrogen in which the Indian soils are primarily deficient. Rock phosphate deposits chiefly at Siagbhum and Trichinopoly provide the second major deficient nutrient. Minerals providing minor elements like manganese in the form of pyrolusite, boron in the form of bore and molybdenum in the form of molybdenite occur in different parts of India. Deposits of materials useful as soil amendments like lime stone and marl and gypsum are also available in sufficiently large resources.

3. DR. B. RAMA MOORTHY (New Delhi) :

It was shown earlier that the reflectance spectra of ignited soils can be used to determine the dominant mineralogical composition of their clays. It is now shown that for soils low in organic matter, this can be done from the reflectance spectra of the soils even without ignition and the results are in agreement with the conclusions of Bagehi using X-ray analysis. It is shown further that knowledge of the chief individual members of the different types of clay-minerals present in the soil can be obtained by comparing its reflectance in the violet region before and after ignition. In this way, the presence of the highly hydrated members like montmorillonite and halloysite can be distinguished from others of their own type, if there is practically no change in this violet reflectance.

Semi arid conditions acting on the basaltic trap rock seem to produce dominant amounts of montmorillonite in the soils. Semi arid and arid conditions on the other hand on the once marine Indo-Gangetic alluvium seem to produce a dominance of illite while perhumid conditions seem to produce members of the Kaolinite group whether the soil is derived from the above alluvium or crystalline gneisses and granites.

Jointly with the Section of Botany.

XXI. PLANT BREEDING METHODS IN RELATION TO PHYSIOLOGICAL AND BIOCHEMICAL CHARACTERS.

1. DR. N. PARTHASARATHY (Cuttack) :

The two ways in which modern plant breeding differs from that of the past are first, the more conscious direction of breeding research to the solving of definite problems and secondly, the development of a more scientific approach and technique. Breeding for such characters like earlier ripening, better quality, stronger straw, longer keeping powers and resistance to flood, frost, drought, salinity, diseases and pests has now become possible, while until not very long ago, the only character dealt with by the breeder was yield potential. In breeding for all such biological and physiological characters, it is important to have critical

tests or correlations to evaluate the character under study and to understand the mode of inheritance of the character.

In many physiological characters like drought and frost resistance, the uncertain nature of morphological, physiological and physico-chemical characters as indices of resistance, has made it necessary to adopt the direct method of testing in the field or by pot experiments in drought and cold chambers. However, by careful studies many useful correlations have been worked out. A cytological study of the tapetal cells in plants grown under cold conditions is made in Japan to determine cold resistance in rice. Even in breeding for disease resistance, where it is relatively easy to incite artificially disease conditions and score the progeny for resistance or susceptibility, simple anatomical or cytological correlations sometimes greatly simplify the breeder's task, e.g., correlation between the number of dead epidermal cell layers and resistance to scab in potato. Other valuable correlations are osmotic pressure in estimating saline resistance, schlerenchyma development in non-lodging studies, micro-chemical tests in estimating oil content in linseed and nicotine content in tobacco, height and thickness of the stem in studying fibre content in jute, thickness of bran layer in estimating nutritive value of rice, gluten content and baking quality in wheat, specific gravity and chipping quality in potato etc.

The actual breeding procedures to be adopted will depend on the nature of inheritance of the character. In certain cases like breeding for disease resistance, the task is complicated by the constant origin of new races of the concerned fungus. Since it appears that in several instances, the centre of origin of resistance genes in the host plant is also the centre of maximum variability of the concerned parasite, the breeder can try to breed for resistance to the most virulent races occurring in such areas. A recent suggestion by an American worker concerning breeding a 'composite wheat variety' against the attack of *Puccinia graminis tritici* can be extended to other crops with similar problem. Such a variety when distributed commercially will be a mixture of many phenotypically similar lines which are genotypically different for resistance. It should however be emphasised that we need more fundamental information on the mechanism of resistance in the host plant and the mechanism of origin of new strains in the pathogen before we can organise breeding for disease resistance on more rational lines.

Finally, cyto-genetic studies are important both to overcome cross-incompatibility problems and to transfer the desirable character along without introducing many undesirable features, when the donor parent happens to be a member of a different species or genus. The role of such studies in potato and wheat breeding methods is pointed out.

2. DR. R. D. ASANA (New Delhi) : *Physiological Considerations of the Problem of Breeding Drought-resistant Wheat.*

Since nearly two-thirds of the area under wheat in India has scant facilities for irrigation, breeding of improved varieties for unirrigated land is of obvious concern to us. The plant breeder requires some suitable index or indices of drought-resistance to aid his breeding programme. The results of physiological investigations conducted at the Indian Agricultural Research Institute, with this purpose in view, are reviewed.

The variation in soil moisture, obtaining in unirrigated land, during the life-cycle of the crop has been discussed in the light of the two important soil-moisture constants.

The most suitable criterion of drought-resistance, from agronomic point of view, is yield and as such the influence of drought on physiological processes directly connected with yield should be assessed but unfortunately precise infor-

mation on this relationship is lacking. The effect of soil drought on the three important ear characters, directly concerned with yield, namely, ear number, grain number per ear and 1000-kernel weight was, therefore, investigated, both under pot and field culture. The effect of each character on yield was estimated by calculating standard regression coefficients and it was found that when soil-moisture was adequate, ear number very largely influenced yield, whereas under deficient soil moisture, the other two characters had more or less the same effect as ear number. It is suggested that varieties possessing high values of all the three characters might perform relatively better in unirrigated land and attempt should be made to breed such varieties.

3. DR. G. S. MURTY (New Delhi) : *Biochemical Aspects of Plant Breeding with special References to Wheat.*

For a scientifically planned programme of plant breeding, a knowledge of the nature of the problem, inheritance of the concerned character and its relationship with other characters is essential. Fundamental studies in the field of biochemistry have thrown light on the nature of several characters in crop plants, including wheat. But a study of the inheritance of the biochemical aspects of such characters is a relatively under-developed field of work. Studies of this nature depend in turn on the development of specific tests which should be simple and accurate for measuring the characters concerned. The test should be applicable even for a small amount of the material collected from a few plants or preferably from a single plant so that, it would be possible to collect the data on segregating populations.

Sugar-content and osmotic pressure of the sap are known to be usually associated with frost hardiness in wheat although, a strict correlation of this nature has not yet been established. It is probable that in cases where frost injury is high, carbohydrate-content is low. It has been suggested by some workers that resistance to frost, drought and heat is basically similar and that resistance to one of these adverse conditions denotes resistance to the others. The inheritance of resistance to cold in wheat has been studied by Worzella. Indications were that cold resistance was a quantitative character conditioned by several genetic factors. These studies also included characters like granulation, carotenoid pigment-content, crude protein-content, kernel weight and test weight.

It has been observed by several workers in recent years that phenolic compounds and gums produced in the plant body are responsible for rust resistance. These explanations, however, cannot account for physiologic specialisation. It is likely that serologically distinct proteins, species-specific in nature, might be the basis of physiologic specialisation. It seems worthwhile that greater attention should be paid to this approach to an understanding of the nature of reaction to rust attack and genetic analysis of the R-S factors that appear to be associated with specific proteins in wheat.

4. DR. J. THULJARAM RAO (Coimbatore) : *Sugarcane Breeding Methods in relation to certain Physiological and Biochemical Characters.*

The production of good hybrid varieties in sugarcane depends more on finding suitable parents through experimental crosses, on assessing their value, and on raising a large population of seedlings in the hope of chancing on a suitable variety. The criterion for the selection of parents is generally the actual performance of the varieties in cultivation under the various soil and climatic conditions and their behaviour in breeding. In view of the low percentage of selections in the progenies, and the long duration of the crop, it has become necessary to establish indirect correlations between simple morphological, anatomical or other

characters and the known economic characteristics so that valuable seedlings may be spotted out during the seedling stage itself.

The chief economic characters in sugarcane are yield of cane and the sucrose content in juice. The former is mainly a function of the physiological attributes of tillering and growth. Suitable parents are available for production of high yielding and/or high sugared types. The existence of an inverse relationship between yield and nitrogen content, if fully confirmed, may necessitate the production of varieties with low nitrogen content. Resistance or at least tolerance to adverse conditions like drought, frost, submergence etc. is necessary in improved sugarcane varieties if they are to survive under the climatic conditions in North India. In view of their good performance under North Indian climatic conditions Co. 205, Co. 285, Co. 453 etc. have been used as parents in breeding for these conditions, and the results have been encouraging. Certain discriminant functions of drought resistance may prove of use in the selection of useful types in the seedling stage. Varieties with different maturity periods have been evolved to suit the needs of the industry. Other physiological or biochemical characters like pith, chemical composition of juice, starch content in stem have been studied.

5. DR. R. R. PANJII (Coimbatore) : *Physiological and Biochemical Characters in Saccharum Spontaneum and their Significance to Sugarcane Breeding.*

The hardiness shown by the present-day hybrid sugarcanes has been attributed by cane breeders to characteristics inherited from the wild parent, *Saccharum spontaneum*. In the wide variation and adaptability shown by this species, much scope exists for choice of parents. A survey of the physiological and biochemical characters in the wide range of variants of this wild cane would therefore be an important step towards the improvement of hybrid canes.

Among the physiological characters concerned in drought-resistance, osmotic concentration of the cell sap appeared to be the most important in the case of *spontaneum*; a survey of about 30 variants to-date has shown a variation ranging from 0.28 to 0.65 molar in terms of potassium nitrate as against 0.30 in *S. officinarum*, and 0.60 in *Erianthus munja*. Grown in graded saline culture solutions, some variants appeared to have greater tolerance to salt than others.

Among the biochemical characters, the sugar content of juice is very important. A survey revealed spontaneums with sugar contents as high as 14% in juice. An interesting finding is that the juices of some variants give negative readings presumably due to an excess of levulose. This fact may have implications on the limits of purity attainable in hybrids; it also emphasises the need for testing varieties by the double polarisation method, especially where invert sugar content is high.

There is a wide variation in the amount of starch contained in the internodes. Starch in juice interferes with clarification. With a proper choice of parents, the breeder may steer clear of this factor, especially as variants of *spontaneum* without starch appear to be homozygous for this character.

While the high polyploidy and heterozygosity of *S. officinarum* variants has placed a barrier in the way of improving progenies, the study of and selection among clones of *spontaneum* would perhaps help to enhance the efficiency of breeding.

6. DR. S. M. SIRCAR (Calcutta) : *Breeding in relation to the Physiology of Rice Plant.*

Problems of breeding rice varieties should be approached from a consideration of the behaviour of the plant towards the environmental factors. A great deal of

our present day researches on *ad hoc* experiments have produced little practical value. This is primarily due to the lack of proper consideration of the physiology of the plant. Fundamental knowledge of the reaction of the rice plant towards a set of environmental factors forms the basis of the procedures to be followed for the effective breeding of rice varieties. This is more evident from some of the present day important problems of rice breeding, e.g., resistance to lodging, flood, drought and salinity, varietal differences in response to fertilizers under different climatic conditions, ecological characters of varieties of different regions, improvement of the nutritional value of rice by increasing the protein and vitamin contents.

In lodging apart from the morphological and anatomical considerations, the response of plants to N.P.K. supply under different climatic conditions is to be noted. Similarly the problems of breeding, drought, flood and salinity resistance are associated with the phases of plant development and its metabolic sequences.

Ecological classification of varieties form a very potent factor in plant introduction and improvement by hybridization. Reactions to photoperiods and the prevailing temperatures at different phases of plants are the causative effects of sterility often noticed in rice culture. Lastly time has come to evaluate the nutrition of the different rice grains and to evolve varieties having more food value. This again is determined by soil and environmental conditions.

7. DR. G. V. CHALAM (Cuttack) : *Uptake of Water and Solutes by the Spikelet of Oryza Sativa.*

Experiments regarding the entry and path of water and solutes in to the paddy spikelet have been conducted. For the study of entry of water, initially weighed, basal and apicular portions of paddy spikelets with cut ends sealed were fixed in cork-rafts and floated in water. Weighments were made at intervals of 6, 20, 48 and 72 hours, in comparison to the whole spikelet. It was found that there was absorption at both the ends and the absorption is more up to a period of 20 hours at the apicular end. Later on it was more or less the same. In the distribution of water through the entire surface of the spikelets also up to a period of 15 hours the concentration was more at the apicular end and ultimately after 30 hours the concentration was more at the basal end.

For the entry of solutes iodine, Brown's Silver nitrate method and eosine were studied. In all these experiments three paths of entry were definitely established by testing the kernels. Three paths of entry were found to be viz. (i) Inter-locking, (ii) Through the middle vein of lemma, (iii) Through the non-lignified portion of the lemma over the embryo. In these cases also relatively the entry at the apicular is greater and quicker. It is presumed that the vein ends of the lemma at the apicule are open, which facilitate an early entry.

8. DR. D. K. MUKHERJI (Calcutta) :

During the last half a century, breeding methods have been remodelled and adjusted according to the necessity. The physiological and biochemical characters desired in a variety require utmost care and ingenuity of a breeder and various complex and intricate tests have to be made to achieve his goal. Thus, production of a salt, flood, disease-, pest or drought-resistant or a winter-hardy variety needs testing for the specific characters at various stages of breeding, for wider range of adaptability, multiple-cross method or testing of F_2 progenies under various soil and environmental conditions is resorted to, and so on. For efficient utilization of manures or for reaction of a variety to other chemicals, a breeder has to resort to special tests involving physiological and biochemical techniques, such as artificial culture of excised embryos or plants in nutrient media etc., and analyse the

results at various stages of his breeding programme. For obtaining a variety having seeds of high nutritive value, of higher vitamin content, better baking qualities and so on, similar breeding methods are adopted. Thus, it is not the morphological characters alone which get attention from a modern breeder, but the various physiological and biochemical characters get greater attention from him and the breeding methods are adjusted and remodelled accordingly.

9. SRI M. B. V. NARASINGA RAO (Samalkota) :

Mendelism, comprising the laws of inheritance of characters has for a long time been supposed to be valid only for morphological characters of plants and animals. But later researches have shown that reconcile physiological characters such as flowering duration, various kinds of sterility, resistance to drought, floods drainage of seed etc. are governed by laws of inheritance. It has however, been brought to the foreground that the environment has a very strong influence on the expression of physiological characters and the study of the 'environment' in its broadest sense has become very important for a proper elucidation of the inheritance of physiological characters.

A distinction has to be made of the two terms "Genetics of physiological characters" and "physiological genetics". While the former deals with the genetics of characters, the latter which has been studied by Goldsmith and others deals with the variability of expression of characters but surely under different environmental conditions. Thus the study of the environment has been found to be of paramount importance.

For a long time to come in this country a great deal of importance has to be attached to the study and improvement of 'Yield' of crops. 'Yield' is known to be a complex character, being the net product of the vital activities of organism in question, and it is essential therefore that the particular visible attributes which go to make up the yield have to be given the proper weight in the breeding programme for yield.

'Quality' in crops e.g. lint length, increase content of cane, oil content of seeds, has recently been added to the list of characters, that could be tackled by plant breeding methods.

Characters which would cause loss of damage by wastage e.g. shattering, non-dormancy of seeds, lodging specially in cereals have all been also brought under the purview of the plant breeder and attempts are being made to improve upon these characters. Most of physiological and quantitative characters such as tillering, length of head in cereals for instance, are governed by multiple factors, the ordinary method of genetical analysis heads down and special branch of Biometrical Genetics is fast developing which helps in the solution of these problems.

A subtle distinction may be made between 'biological' characters and 'physiological characters' under the first category may be exclusively included such characters as diseases resistance and resistance to pests or other organisms. But in these characters it has been found that resistance may sometimes be due to certain modifications in the physiological set up of the host organism and this subtle difference may therefore be very small and not real. The problem of disease resistance is a more difficult study as it has to deal with two organisms, the host and the parasite.

It is hoped that with the combined efforts of the physiologist, pathologist and the classical geneticists, plant breeders hope to produce more prolific, better quality and hardier varieties of crops and animals.

Jointly with the Section of Botany.

XXII. PLANT INTRODUCTION AS AN AID TO IMPROVEMENT OF FOOD AND FODDER.

1. DR. J. C. SAHA (Darjeeling) : *Enrichment of Agriculture through Plant Introduction.*

It is now admitted that cultivated plants have definite "centres of origin", and it was from such primary centres that crop plants were distributed to other regions of the world in the course of the long and remote history of human civilization. In fact, the World and the New Worlds have had few cultivated plants in common before the days of Columbus.

The significant part plant introduction can play to revolutionise and enrich a country's plant husbandry is exemplified by North American agriculture. United States of America can hardly claim any indigenous crops other than pecan nuts, blueberries, cranberries, raspberries, concord grapes, some plums and some strawberries. But today the United States grow varied agricultural crops almost all of which have been introduced by the early settlers. However, few of the exotic crop plants cultivated in India have had any plant introduction behind them; and the few that can claim this distinction belong to a category other than food crops.

The discovery of genes and their incorporation through breeding to the production of new forms of better yielding crop plants resistant to pests and diseases and/or tolerant to extreme climatic and edaphic conditions, have given impetus to explore regions, where a particular crop is supposed to be indigenous, to find new or wild forms of related plants with desirable characters so that genes for such characters might be imparted to improve plants already in cultivation.

Since the turn of the current century, several such plant explorations have been carried by the Russians and the North Americans. These have supplied a rich source of breeding materials for improving, among others, such important crops as potato, sugarcane, corn and other cereals, alfalfa, etc.

2. DR. D. CHATTERJEE and SRI C. L. DHAWAN (New Delhi) : *Better Fodder Plants for India.*

It has been estimated that the cattle population of India is 200 million and the livestock population other than cattle (i.e. horses, sheep, goats, etc.) is another 90 million. The problem of supplying suitable and adequate fodder to this vast number, specially during the dry season, is indeed immense and requires consideration by all. While over 16 per cent of the sown area are placed for growing of fodder plants in Egypt, this acreage would hardly exceed 3 per cent in India. In addition to some of our indigenous fodder grasses like the *dhoob*, *anjan*, *jerga* and spear grass, a large number of exotic grasses and legumes have been introduced during the present century. Their comparative values lie either in their more vigorous growth or in their better nutritive qualities. The most important of these introductions is the Egyptian clover or *berseem* which has proved of definite value to our country. Other introductions are the Napier grass, guinea grass, Sudan grass and Rhodes grass.

Some of the recent introductions of grasses and legumes which have shown distinct promise as a result of trial at the Indian Agricultural Research Institute, New Delhi and other places may be summarised. The African *Bothriochloa inculpta* and *Brachiaria brizantha*, the Australian *Urochloa* sp. and *Paspalum*

notatum from Uruguay have been found to do very well under Indian conditions. Besides the Kudzu vine which has been already popularised by the Vivekananda Laboratory, Almora and the I.A.R.I., New Delhi certain other legumes like the Hubam clover, a variety of Vetch from Cyprus, the creeping indigo of Ceylon, *Centrosema pubescens* and *Glycine javanica* have proved promising and should be made known to the farmers. In areas of heavy rainfall like Assam and some parts of South India, the Para grass of South America is recommended, while the blue panic grass (*Panicum antidotale*) which was originally taken from India and improved by selection in Australia, is now successfully re-introduced in the semi-arid zones of Northern India.

3. DR. NIRAD K. SEN (Kharagpur) : *Improvement of Fodder Legumes in India through Introduction.*

As a nutritious cattle feed and as a soil conserving crop, leguminous fodder plants play an important role in farming. In India most of the legumes used as fodder are pulses or vegetables grown as a catch crop. It is only in recent years that some of them are being raised as farm crops and several of them have only been recently introduced.

Of the recently introduced types *alfalfa* has a great potentiality. Suitable strain of alfalfa, grown in fertile soil under irrigation, is decidedly the best fodder legume. Success of alfalfa over an extensive area throughout the world is mostly due to production of strains adapted to local conditions, in which introduction has played a great role. There is a considerable scope to introduce *Lespedeza* on marginal lands and in regions of acid soil and some of the strains are extremely drought resistant. On steep hillside and in eroded gullies, recently introduced Kudzu is performing very well. Among the clovers the *Egyptian clover* is gradually becoming popular in the irrigated tracts, but a fair trial has not yet been given to the high yielding types of red clover, white clover and sweet clover. *Strawberry clover* is one of those rare plants which can stand wet alkali soil.

Among the other fodder legumes commonly grown in India like *cowpea*, *grass pea*, *horse gram*, *moth bean*, *rice bean*, *velvet bean*, *Indian clover* and *fennugreek* the breeder is limited by lack of much variability in his local collections. A greater gene fund should be made available to him by introducing desirable strains from abroad and also by collecting their wild relatives from areas of greatest diversity. In conclusion it may be said that today in India, among all the farm crops, fodder legumes have the greatest potentiality for improvement through introduction.

4. DR. G. S. RANDHAWA (New Delhi) : *Introduction of Fruit Trees in India and Development of the Fruit Industry.*

Introduction of new fruits and fruit varieties from one country to the other has been made since early time. Many such introductions have been surprisingly successful e.g., introduction of grapes from Spain to Cuzco, Washington Navel orange from Brazil to California and avocado, guava, pineapple and papaya from Tropical America to India. The trade relations existed between India and other Asian countries like Arabia, Burma, China, Malaya and Indo-China as early as the 13th century. Many fruits like date, peach, pear, mango, banana and some citrus fruits were then introduced in India. Later on several temperate, sub-tropical and tropical fruits were introduced in India from Tropical America, Europe, China, Brazil and some other countries.

The introduced fruit trees play a significant role in improvement of our cultivated tree fruits. Many of their desirable characteristics like resistance to drought,

insect pests and diseases or high yield and better fruit quality could be transferred to the cultivated forms by hybridization followed by selection and testing of the resultant seedlings. Explorations of wild forms, of fruit trees, from unexplored regions, which are drought-resistant, winter-hardy or immune to insect pests and diseases may greatly help our future fruit breeders in evolving varieties suitable for unfavourable environments.

Introduction of Tropical American date palm (*Bactris utilis*), pecan (*Carya illinoensis*) and tropical apple from Israel is suggested.

5. DR. H. L. CHAKRAVARTY (Calcutta) : *Introduction of Food and Vegetable Plants in India.*

India occupies an advantageous physio-graphical position in having in her extensive territories climate and soil of varied types ranging from temperate dry or temperate moist conditions to moist and dry warm zones. Our extensive fertile plains, lofty mountain ranges, long terai expanse, vast swamps and arid central zone can very well accommodate types of vegetation suitable for settlement from similar localities beyond the seas. We are passing through food crisis particularly as a result of partition after the second World War. Gigantic projects have therefore been launched to face the challenge of food shortage and natural calamities, and Government have taken up the problem of scarcity on a war footing. Agriculture has been given the primary importance in our all round enterprise with the object of flourishing the country with plenty. In this paper the author has attempted to show with reference to plant types that it is worthwhile to introduce certain foreign plants of economic importance in similar ideal Indian climate. These plants include those which have sufficient nutritive value as an article of food or vegetable.

As an experimental measure certain plants may at first be selected for introduction. These may be procured by barter or by purchase. Knowledge of local ecological or meteorological conditions of the importing countries with the conditions prevailing in the proposed area of introduction are prerequisites.

6. DR. L. S. S. KUMAR (Poona) : *Introduction of Forage Plants.*

One of the most important methods of increasing the productivity of food and fodder resources of a country is by plant introduction. Plant introduction dates back to early history of mankind. Plants have been introduced from one country to another by travellers and explorers in early times. Subsequently Government departments have been responsible for introduction of plants of importance. Businessmen, traders and pilgrims have all played a part in introduction of new plants. Probably the greatest exchange of plant material has been between scientists of different countries resulting in introduction of superior types.

Introduction of maize needs a special mention as it has been useful both as fodder and food. Among forage grasses notable introductions include Guinea, Elephant or Napier, Rhodes, Para and Sudan. High importance is to be given to lucerne or alfalfa, berseem and soyabean among forage legumes.

Among recent introductions of forage grasses and legumes the following need special mention. Blue Panic, Japanese Kudzu and Koo babul. There are many other fodder grasses and legumes introduced from abroad that have become adapted and are proving superior to local types.

Plant introduction is one of the means of enriching the economic plant wealth of a country. To do this work successfully what is required is a central and regional organisation on the lines of the Bureau of Plant Introduction of the U.S.A. and similar organisation in other countries. This country should have an organisation to undertake such work on scientific lines.

7. SRI M. B. V. NARSINGA RAO (Samalkota) : *Plant Introduction as an Aid to Improvement of Food and Tackles.*

The romances of plant hunting by different people in different epochs and in different parts of the world make very pleasant reading. The absorbing interest which the early kings and even monks had shown towards gardening has helped the development of plant sciences to a large extent. New crops e.g. tea, coffee, tobacco, oranges etc. have been introduced into new areas and such historical examples are many. These may be termed fortuitous introduction.

After the rediscovery of Mendel's laws and concept of variety as an assemblage of factors, it came to be recognised that for successful and sound breeding programmes it is necessary to have a new and superior germ plasm. The sources of this germ plasm are the large number of varieties available in a particular locality, the large amount of material in the places the crop is long cultivated and the related species and even genera.

A thorough search of all cultivated forms, wild species and even related genera gives valuable results. The explorations of Russian Botanists headed by Vavilov have brought forth results of not only high scientific interest but of immense practical value to plant breeding. According to him the longer a crop plant had been established in a given area the larger the number of allied species that one can find there. It also abounds in a wealth of forms with rare genes and superior germ plasm. By the law of Homologous or parallel variations we now learn in which regions of the world productive large seeded strains, cereals with solid straw, varieties resistant to specific fungus diseases and so on can be found.

Some varieties obscure at the moment may contain valuable genes much needed in the synthesis of a new hybrid. If these are replaced by forms which are superior to them in some respects, they are lost to us for ever. A valuable function of Agricultural Institutes will be to maintain a collection of as many primitive cultivated varieties of the plant. One of their functions will be the analysis of natural populations, a very useful aspect to plant breeding. Such Institutions are the Plant Introduction Bureau started in U.S.A. and other countries.

While agronomically useful genes may be available in cultivated varieties of the crop plant those which contribute special traits, such as resistance to diseases, drought resistance etc. are usually met with in their wild ancestors of the same genus or allied genera and these may be used for synthesising new hybrids with the cultivated types.

A useful technique called the homoclimate technique is very helpful to formulate introduction programmes. According to this technique similar ecological or agro-climatic areas are delimited in different countries of the world by the comparison of all available data on climate, geography and soils. It should be useful that this technique be developed in all the countries so that it will be of value in the selection of plants for food and fodder for introduction into the countries in question.

A danger usually concomittant with introduction from other climes is the possibility of introducing harmful pests and diseases along with crop plants. A powerful

Quarantine section has to be set up in each country which envisages plant introduction.

8. DR. S. KRISHNAMURTHI (Annamalainagar) : *Plant Introduction as an Aid to Improvement of Food and Fodder Plants in the Nilgiris, the Premier Hill District of South India.*

The hill zones of India in general represent a region which has shown fairly outstanding success of plant introduction as means of establishing and acclimatising a number of crops vital to the economy of the area particularly and of the nation generally. Cinchona, rubber, tea and coffee are good examples of the benefit of plant introduction. Nilgiri Hill District in Southern India has been especially an active centre of plant introductions for over a century. While being famous for its cinchona, coffee and tea, it has had a number of introductions of food and fodder plants suitable to the hill zones. This paper deals with the success achieved in the Nilgiris in introduction and improvement of fodder plants, and food plants under which are included also the potato, fruits and vegetables, as they are part of food.

Of these food crops, potato occupies the most important place in the agricultural economy of Nilgiris and potato from this district reaches markets of Ceylon, Bombay, Calcutta and other distant places. The first introductions of potato were made in 1822, and the improvement of potato as a commercial crop on the Nilgiris since then has been mainly through introductions of varieties from abroad, varietal trials among these to test performance, and to acclimatise the high yielding varieties. Of all these, the "Great Scot" has till now occupied the front place because of early maturity, round medium tubers, smooth white skin, hard flesh and good keeping quality and yield.

Nilgiri District is one of the very few zones in South India where wheat is grown, and the establishment of wheat on these hills is entirely due to introduction of suitable varieties from abroad. Recently rust resistant types of wheat imported from Australia such as Celebration, Charter, Gebo and Kendu have been promising substitutes for the varieties at present grown in the Nilgiris.

The commercial cultivation of temperate vegetables on the Nilgiris such as cabbage, cauliflower, knolkohl, beetroot, carrot, turnip, peas and beans for which this hill district is famous owes its position to introductions from abroad.

Among fruits, besides the apple, pear, peach, plum and strawberry, the Nilgiri district has achieved resounding success in establishment of such exotic fruits as avocado, cherimoyer, mangosteen, durian and persimmon. Nilgiri district is the only zone in India possessing commercial orchards of mangosteen and is one of the few zones in the world where mangosteen is a success, and this is largely due to plant introduction.

Barley, buckwheat, oats and lentil are other food crops which owe their establishment on the Nilgiris to plant introduction.

Among the fodder and pasture plants, Kikuyu, *Pennisetum clandestinum* introduced from East Africa has widely spread in the Nilgiris. Among others about which record of introductions is available are berseem, subterranean clover, lucerne, napier grass, buffalo grass and guinea grass.

9. DR. S. M. SIKKA (New Delhi) : *Plant Introduction as an Aid to Improvement of Food and Fodder Crops with special Reference to Wheat.*

The rapid advances made recently in plant breeding techniques have resulted in the evolution of superior strains of crop plants and differentiation of ecotypes

suitable for cultivation under a wide range of climatic conditions. The introduction of such materials from one country to another and their evaluation and utilization in breeding has been universally regarded as one of the most important methods of crop improvement. This has led to the establishment of Bureaux of Plant Introduction and Exploration in all the agriculturally advanced countries of the world.

There are numerous examples of notable successes achieved in different countries in evolving new varieties of crop plants of great economic value by utilizing introduced varieties either for hybridisation or for direct selection. A classical example is that of *Marquis* wheat, which stood out for years as the greatest achievement in wheat breeding history of United States of America and founded the hard spring wheat industry of that country. The seed sample from which this variety was evolved came originally from Galicia in Poland. The seed subsequently passed through a number of countries, e.g., Germany, Scotland and Canada before it reached the United States where a single-plant selection made therefrom gave rise to the famous variety, *Red fife*, which in turn was the parent of *Marquis*. In later crosses, *Marquis* passed on its superior characters to several American and Canadian wheats. The origin of this variety and its subsequent utilization for extensive cross breeding work not only in America but also in other countries shows how plant breeding cuts across and disregards national boundaries to develop products useful to all men and all nations.

The utilization of introduced varieties has played its role in the improvement of the wheat crop in India also. This line of work was initiated during the first decade of this century when the indigenous varieties, *N.P. 52* and *N.P. 4*, were improved for yield and resistance to the smut disease by crossing them with the Australian variety, *Federation*. Since 1933-34, a more systematic and broad-based programme for the collection, maintenance and study of foreign wheats has been followed at the Indian Agricultural Research Institute, New Delhi. From a collection of more than 2,500 exotic wheats, about two dozen varieties have been successfully used for imparting a high degree of rust resistance to Indian wheats apart from immunity from the smut disease. It has also been possible to introduce directly one variety *Ridley*, for cultivation in the hilly tract of Northern India.

The useful results achieved from introduced wheat varieties well justify the establishment of a full-fledged Bureau of Plant Introduction and Exploration in India.

10. SRI HARBHAJAN SINGH (New Delhi) : *Plant Introduction as an Aid to the Improvement of Food and Fodder Plants—Vegetables.*

India grows a wide variety of vegetables not all of which are indigenous to this country. The region comprising India and Burma contributed largely the tropical vegetables commonly grown in this country. Continued migrations of vegetable crops from one region to the other resulted in the rich diversity that we see today. In India, the work on the breeding of vegetable crops has so far received but meagre attention. As such, introduction of plant material from abroad would certainly be expected to play a very important role.

In the future, there seems to be greater scope for introduction and utilisation of new varieties of vegetable plants rather than of wholly new plants. Introductions made in recent years, by the Plant Introduction Section at the Indian Agricultural Research Institute, have shown the vast possibilities of effecting improvements in vegetables through plant introduction. Varieties such as 'Sioux' in tomato, 'Early Badger' and 'Bonneville' in garden pea, 'Philippines Early' in cowpea (*lobia*), F.A. 17' in sweet potato, 'Bermuda Yellow' and 'Texas Grano' onion, 'New Hampshire Midget' watermelon have given good performance in

comparison to local varieties. The tomato variety 'Sioux' and the *bhendi* variety 'Green Velvet' both American, have further been successfully used in breeding better varieties. Special breeding materials such as the male sterile lines in tomato and onion, for the production of hybrid seeds, have also been imported.

Collection and utilisation of wild relatives should also receive adequate attention. The use of South American wild species of tomato and potato is well known. The tomato variety—Hybrid-6 which is rich in vitamin C and sugar content, is a selection made at the I.A.R.I. from crosses made with the wild South American species *L. pimpinellifolium*. In *bhendi* a newly described indigenous wild species, *A. tuberculatus* Pal et Singh, seems to hold promise as breeding material for breeding for resistance to yellow-vein-mosaic in the cultivated crop; it would be worthwhile searching for, and utilising, exotic species of this genus for breeding for hardiness and disease resistance.

If this process of introduction is accelerated, systematized and its scope widened we can expect to make further profitable additions and improvements in our vegetable crop varieties.

11. DR. A. B. JOSHI (New Delhi) : *Plant Introduction as an aid to the Improvement of Food and Fodder Plants—Root and Tubers.*

A considerable range of root and tuber crops is grown in India. Many of these plants, e.g., the aroids, yams and others, are believed to be indigenous to this country. Many of the important present-day root and tuber crops of India, e.g., the potato, sweet potato, tapioca, radish, carrots, turnips and beet are however foreign introductions.

The usefulness of introduced varieties and related species in the further improvement of these crop plants is indicated.

The need of establishing a well-organised central bureau of plant introduction in India for carrying out this valuable work is imperative.

XXIII. TEACHING OF AGRICULTURE.

1. DR. P. K. SEN (Calcutta) :

Teaching of Agriculture has two aspects. One is professional, turning out trained personnel of all categories for the departments of Governments or for private institutions. Another is general, providing an economic foundation of a way of life based on the philosophy of co-existence and non-violence.

The object of education is to develop the faculties of man, thinking and acting, with a view to producing goods and conditions of a happy community life. Food is needed by every body but the overwhelming majority of people is yet unable to meet this primary need. Obviously, therefore, the concerns of food should form an objective basis of education for the community as a whole and agriculture should form an integral part of liberal education.

Placing education on an objective basis of agriculture and allied crafts meeting the primary needs of life, as was advocated by Mahatma Gandhi, would reduce the limiting effects of money on extension of education, promote thoughts and actions of self-help and co-operation among individuals, and advance peace in the world.

Consistent with India's standpoint, the educationists of the country have seen the importance of agricultural teaching from primary to the highest stages of education, in its proper bearings. The principle accepted has yet to be worked out in all its detail in our educational plan. Agricultural teaching has so far been a charge of the Ministries of Agriculture mainly concerned with training personnel for their departments. It has continued to remain so even in the changed circum-

tances. It is a matter for serious consideration whether or not Ministries of Education should now take up agricultural teaching along with education as a whole. While we need a very large number of trained personnel for our expanding research and development work in agriculture, we need an even larger number of qualified agricultural teachers for our schools throughout the country for above all we have to bring about a change in the background of life with a view to achieving our cherished ideal. Bearing this in mind the following pattern of education is suggested :

Primary or Junior Basic Education

(Age group : 6-7 to 10-11)

General introduction with a view to creating interest in agriculture and allied crafts.

Weightage—25% of curriculum

Junior Secondary or Senior Basic Education to begin with at least in rural areas.

(Age group : 11-12 to 14-15)

Practice of agriculture and allied crafts in a productive way.

Weightage—50% of curriculum



Senior Secondary or Post Basic Education.

(Age group : 14-15 to 16-17)

Agricultural		General		Technical	
Weightage		Weightage		Weightage	
Practice of productive agriculture and introduction to its general theories ...	75%	Arts & Science	75%	Practice of productive crafts and technology and introduction to their general theories ...	75%
Humanities and Basic Science ...	25%	Practice of productive Agriculture and allied crafts	25%	Humanities and Basic Science ...	25%

Agricultural



Arts, Science, Medical etc.



Technological.



Collegiate Education.



Post-graduate Studies : Specialisation.

2. SRI HARISH C. SAXENA (Allahabad) : *Teaching Animal Nutrition.*

Animal nutrition has become a very important aspect of modern livestock production. The nutrition knowledge has advanced tremendously during the last ten years. Further research is continuing to discover new reproduction, lactation and growth factors. With all these developments the subject of animal nutrition is becoming increasingly complex.

Teaching of animal nutrition should, therefore, be planned keeping these developments in view. Most colleges offering degree courses in Agriculture or Veterinary Science teach courses in animal nutrition. The time allotted to the subject, the syllabus and the approach to the subject varies from college to college.

For purposes of a discussion on training in animal nutrition the subject matter may be divided into three specific learning areas :

1. Subject matter areas within the field of animal nutrition and allied subjects to support the understanding of animal nutrition;
2. Techniques considered necessary for an animal nutritionist; and
3. General learning areas considered necessary to give breadth of understanding and appreciation of the physical and social world.

Prominent among those which are extremely necessary for the understanding of the subject matter of animal nutrition are Biochemistry, Bacteriology, Physiology, Anatomy, Statistics, Agronomy, Agricultural Economics and Veterinary Hygiene. Students in most agricultural colleges seem to have an inadequate background in organic chemistry and therefore have difficulty in understanding biochemistry, so necessary for understanding of animal nutrition. Importance of bacteriology is being realized and most colleges are teaching courses in this important subject. Great stress should be given on the allied subjects related to the field of animal nutrition in addition to the chief importance that is laid upon animal nutrition itself.

It is necessary to provide the students a thorough understanding of the techniques of the skills that are needed by an animal nutritionist. Practical work should be greatly emphasized in all related fields. It is a matter of great concern to us that most colleges do not provide enough facilities for learning techniques for lack of technical personnel and equipment. Students should be given a chance to conduct nutritional experiments using small animals as well as large animals. The results of such trials should be analyzed statistically by students. This will give them sound ideas on planning the nutritional experiments. Above all they should also be given instruction in general learning areas which will provide them the wisdom for the solution of those problems with which all men are confronted as human beings.

3. SRI B. NARASIMHAM (Bapatla) : *Teaching Horticulture.*

The art of teaching, which exerts a lasting influence on the development of the country, is to be acquired by long experience. The administrative transfers of teachers into the general department in vogue in the Colleges run by Government is not conducive to efficient teaching.

Horticulture should be independent section in the College for adequate attention and since it consists of at least three unlike divisions, viz., fruits, vegetables and ornamental plants—there should be a separate lecturer for each of the subjects.

Post-graduate study and research facilities should be available at the Colleges and especially at the Indian Agricultural Research Institute for specialisation.

Should the students gain the necessary confidence to earn an independent living after graduation, the stress in Agricultural instruction in general and horticultural education in particular should be on the practicals rather than on theory. To this end, the examinations with their greater stress on written tests conducted during the brief period set for the purpose to be suitably modified.

The practicals should not be confined merely to the local practices but should include latest and advanced methods which are usually touched upon only in the theory classes.

The students should have opportunities of working on actual crop plants and not on shoots or mock plants to give them a sense of reality. What is taught in

the class room has to be practised in the field in the institution. Conflicting professional opinions should be taught only after the students are thorough with one of them.

It should be desirable to allot more hours for field subjects like Horticulture in the first and second terms, i.e., in the busy season and the consequent reduction in laboratory classes is made up by having more of them in the last term. This gives the students a greater and more frequent touch with the plants.

A model set up is submitted for efficient handling of the subject.

It is essential that there should be periodical conferences of teachers of Agriculture subjects from all over India to discuss common problems, exchange views and make recommendations.

4. SRI P. GOVINDARAO (Bapatla) : *The Teaching of Plant Pathology in the Agricultural Colleges.*

The author feels that there are a few lacunae in the teaching of Plant Pathology in the Colleges of Agriculture in India. A good and well written text book on plant pathology giving all details of the diseases occurring on the crops grown all over India seems to be the first need. It is suggested that the Head of the Division of Mycology and Plant Pathology, Indian Agricultural Research Institute, New Delhi might take up this work as he is in a position to know as to what is happening in India. The second need is for the creation of an agency to collect information about the availability of fungal forms in and round about all the Agricultural Colleges in India and arrange supplies either for cost or for exchange. The third need is the stress to be laid on the teaching of fundamentals in the Colleges. Growing of specimen diseased crops in the pot culture houses attached to the Institute or the College with the aid of the artificial infection in the laboratory and the systematic tours of students to places where epiphytotics are occurring and where disease control operations are being carried on, would impress the fundamentals on the student.

5. DR. R. H. RICHHARIA (Sabour) : *Teaching of Agriculture at the Bihar Agricultural College, Sabour—A scheme for the re-orientation of the system of practical training, as introduced.*

The reorganisation of agricultural education with special reference to giving more practical bias has been receiving active consideration of the agricultural educationists. As a first step, we have decided to intensify the practical training at the College within the bounds of the existing syllabus of the Bihar University but with a view to turning out soil-minded scientific farmers, capable of taking to Agricultural Industry after getting their degrees.

The central idea is to run the College Farm (200 acres) purely by the students under the management of the Agronomy group of the College. The students themselves would work where casual labour was previously employed. This will not only improve the agricultural training of the boys by giving them an overall idea about farm management and agricultural practices, including clear conception of the whole process, but also enable them to acquire practice and develop stamina for working out-doors at a stretch of 8 hours a day. This has necessitated re-planning of our daily established routine, reduction of holidays from 152 to 110 days (about 31 working weeks), re-arrangement of examinations and conducted tours.

According to this routine the students of one class (Year) will be at the Farm (The Bihar Agricultural College has a three-year course after I.Sc.), i.e. 70 boys will always be available at the Farm and the remaining two classes will be having theoretical lectures and laboratory practicals. The practical classes will include

Agronomy, Animal Husbandry, Veterinary, Horticulture, Rural Extension and Engineering and the Laboratory will include Botany, Entomology and Zoology, Chemistry and Mycology, besides theory classes in all subjects. In other words in every 3 weeks, each class will have one turn of one week at the Farm and two turns (of two weeks) in the class.

For the purpose of conducting field practicals and keeping in view the syllabus for courses of studies, 6 units have been formed at different parts of the Farm and practical work in which students will be working in batches of about 12 each, rotating from unit to unit after every two days during busy season and weekly otherwise.

The minimum percentage of lectures have been fixed as follows :—

In practical	75%
In Theory	67%

A sample of the weekly programme drawn up is reproduced below :—

"The following rotation will be followed for Field work of 1st year class for the week from 12th to 19th July, 1954."

Date	North Section	South Section	Godown Implement	Dairy & Poultry	Survey & Engineering	Miscel- laneous & Estate
12-7-54	... 1	2	4	3	5	6
13-7-54	... 3	4	6	5	1	2
14-7-54	... 5	6	2	1	3	4
15-7-54	... 2	3	5	4	6	1
16-7-54	... 4	5	1	6	2	3
17-7-54	... 6	1	3	2	4	5

As regards records of the work done by each student, a field practical work card (system) has been evolved where daily progress, made by the student, is recorded and work reviewed by the Professor of Agronomy at the end of the week, which is then further scrutinised by the Principal.

A comparison, between the system of practical training and the system followed in the past, shows that we have increased the number of total working hours from 3126 to 4212. Whereas we have not undermined the importance of theoretical knowledge we have given weightage to practical farming.

To help the students to undertake long hours of strenuous work, certain amenities have been provided viz., free breakfast, free afternoon tea and refreshment and other facilities.

6. SRI A. C. PANDYA (Anand) : *Teaching of Agricultural Engineering.*

Agricultural Engineering is taught as one of the several subjects in Agricultural Colleges of the Indian Universities. Agricultural Engineering can be divided in the following branches : (1) Farm Power and Machinery, (2) Soil and Water conservation including Irrigation, (3) Farm Structures, (4) Rural Electrification, (5) Farm-produce processing and (6) Rural Water-supply and Sanitation. Syllabi of most of the Universities cover first three branches. Main topics involved are surveying, irrigation, soil erosion control and water conservation practices, farm drainage, farm engines and machines, and farm structures. Students have no background of engineering principles except elementary courses in Physics and Mathematics. Suggestions for modifications in existing syllabi of Physics, Mathematics and Agricultural Engineering and a proposed syllabus of Agricultural Engineering are given.

Approach to teaching Agricultural Engineering should not be mathematical but it should be taught with help of prototypes, models, drawings, and charts, and

by carrying out tests. There should be greater emphasis on students doing things by themselves. There is a great need for text-books of Agricultural Engineering suitable to Indian students. Suggestions are made for post-graduate education for agricultural graduates in Agricultural Engineering.

7. DR. S. KRISHNAMURTHI (Annamalainagar) : *Productive Enterprise Projects and Other Aids for Teaching Agriculture in the Colleges.*

Agriculture is an art, an applied science and a method of making a living. All these three aspects emphasise the need for making teaching of agriculture as practical as possible. It is a general characteristic of the Indian Colleges of Agriculture that a large number of students in these colleges are drawn from the non-agricultural middle classes and therefore practical aids and projects such as "productive enterprise projects" and schemes to increase manipulative ability, are all required to make the teaching of agriculture more effective and to make the agricultural graduates practical agriculturists and practical scientists. "Productive enterprise projects" are projects of great importance in achieving practical efficiency in agriculture among the students. In such projects, the student has a degree of ownership of the plot of land assigned to him and he is allowed to earn money for himself. The central idea is to put him in the position of a farmer, make him undergo his difficulties, but also achieve rewards that the farmer obtains for the difficulties undergone by him. This gives the student a realistic idea of what farming means, and of what improved scientific methods can achieve. Such a scheme has been initiated for the students of agriculture at the Annamalai University.

Agricultural tours and excursions play no mean part in teaching of agriculture and widening the practical vision of agricultural students, but improvements are needed by way of preparations and study of objectives of the tours beforehand to get the maximum benefit out of such tours which normally cost much expenditure.

The paper deals also with the role of specimen crop area, implements' museum, table models of several agricultural equipments for teaching, general agricultural museum, charts, atlases, black and white photographs and colour photographs, and audio-visual aids in teaching of agriculture.

8. PROF. L. S. S. KUMAR (Poona) : *Agricultural Education—Its Present Scope and Future Development.*

Agricultural education in the Bombay State which began in the seventies of the last century has today been organised into a well developed course of instruction. Begun as a non-degree or licentiate course, it has passed through the phase of the diploma course and for the past several decades has reached the degree stage imparted at a level equal to that of any degree course of the University.

The aim of imparting agricultural education at higher levels has been to provide sound theoretical and practical training in agricultural science. The training given is both basic and comprehensive so that it enables the graduate to fit himself to work in any one of the branches of agricultural science with ease. Thus a well trained graduate is sufficiently capable of

1. giving sound advice on modern practices of agriculture to farmers in general,
2. managing and running successfully a farm attached to an agricultural industry,
3. farming on his own provided he has the land and the means to cultivate it, and
4. manning the state department of agriculture in either research, education or extension lines.

Thus among the several possible scopes or avenues of employment opened to an agricultural graduate the one that has provided more opportunities during the past decades and even today is the absorption by the state agricultural department. But the absorption by the state department cannot be in proportion to the number of graduates that pass out every year. Within the last decade the number of agricultural colleges in the Bombay State have increased from one to three and the total number of students admitted and trained as graduates have considerably increased. Since the scope offered for employment in the agricultural department is limited the graduates are seeking employment in other directions.

Until recent years the scope for employment of graduates in agricultural industries has been limited. Among the industries that have developed most is the sugar industry and this has absorbed a fair number of graduates. Other agricultural industrial concerns dealing in materials such as agricultural machinery and implements, fertilizers, and chemicals for crop protection have each provided employment for a certain number of graduates.

Contact with a few graduates has shown that some of them are working as farm managers of either private land owners or of new concerns started for promoting agricultural production of food and money crops.

The number of graduates who take to farming on their own are very few. The reason for this is that the students admitted to agricultural colleges largely belong to middle and lower middle classes, even though quite a few of them come from the farming communities. It is the lack of land and the finance that has handicapped many of them, otherwise willing, to farm on their own.

The agricultural graduate suffers from one great disadvantage which a graduate in medicine or engineering does not suffer from. Since there is very large demand for doctors, a graduate in medicine can set up private practice and can easily make a comfortable living. Similarly an engineering graduate can set up practice as a consulting engineer. A similar scope is not so readily available to an agricultural graduate to enable him to take to private farming or work as consultant. The present state of development of agriculture in the Bombay State or for that matter in the country in general, does not afford an agricultural graduate scope to work as consultant.

The overall picture of the scope for employment of agricultural graduates is thus far from satisfactory especially in view of the fact that a fair number of graduates still remain unemployed. These would be compelled to seek employment in professions other than agriculture, which would be entirely unrelated to their training.

The problem to be considered therefore is what is the place of agricultural graduates in the future set up of agricultural development in the country. Under the national development plan the need for well trained graduates is clearly indicated. In spite of this there are many qualified persons without employment. This would show that there is some flaw in estimating the requirement of graduates in agriculture which needs to be verified and corrected.

For the development of agriculture in the country and to make every citizen agriculture-minded it would be desirable that agriculture should be introduced as a subject in some form or other from the primary school stage upwards. If this is done it will promote two things. It will not only help to develop agriculture but will also open up an avenue of employment to agricultural graduates as teachers in primary and secondary schools. Graduates in agriculture could be given the requisite training as teachers before they are employed.

The widest scope for employment of agricultural graduates would be under the National Extension Service. The work of this service is vested in the Revenue department of the State. Only agricultural graduates can perform the function of National Extension Service in an efficient manner. Since this is an extensive

service there appears to be scope for employing agricultural graduates in greater number.

It is not sufficient to employ agricultural graduates in National Extension Service only but it would be highly desirable to employ them in the revenue departments so that they could in time occupy posts of importance in the district administrative lines. Now-a-days Mamlatdars and Deputy Collectors are mostly graduates in Arts. If agricultural graduates are recruited for such posts and are given the requisite training in revenue administration they would make better officers because of their basic training in agriculture. It should be made a condition that every revenue and administrative officer should have a basic training in agriculture. This principle has already been accepted by Government and arrangements have been made to impart agricultural training to revenue officials. It is therefore evident that graduates in agriculture would make better revenue officers.

If those in authority could bring about the above change, it would make a difference to the standard of students seeking admission to agricultural colleges. Today as the scope for employment for graduates in agriculture is limited students of better calibre of intelligence seek admission into engineering, medical and science colleges and it is only the remnant that try for admission to agricultural colleges. Better chances of employment with an assured future leading to positions of responsibility will definitely attract intelligent students to take to agriculture. To begin with as an experimental measure if Government would assure that twenty-five per cent of recruitment to the revenue department would be reserved for graduates in agriculture, it is bound to result in a change for the better.

It is also very necessary for graduates in agriculture to develop the trait to venture on their own, however disparaging the attempt may seem in the beginning. Organizing of pure seed and reliable fruit stock nurseries is a crying need of the land. Production of honey or poultry on a cottage industry scale, preparation of preserves and juices can all be done on a small scale without the need of much capital. It is only the bold and enterprising that can take to this line as it would demand a great deal of personal exertion and enterprise which is so much lacking in most agricultural graduates of today.

The lot of the agricultural graduates will be definitely better if they would learn the dignity of labour and do things with their own hands not merely while at the college but later on in life too. Further they should be ready to brave the uninviting conditions and the hard life of the villages. Since their services are required for changing these very conditions and the backward state of villages they should be ready to serve in villages where life is simple and inexpensive rather than flock into cities and put up with congestion and high cost of living merely because a few amenities are available. It should also be the endeavour of local administration to do all in their power to remove the disparity in living conditions and standards between village and town so as to make the village reasonably attractive for those whose standard of sanitation and clean living is too high to be willing to stay in villages. If this is done many more graduates would prefer to work in rural than urban areas. The shift of population from towns to rural areas would be desirable for the development of the latter and graduates in agriculture could lead the way in this matter by virtue of their training.

An important factor that acts as a deterrent to individuals in obtaining agricultural education and later on in following up agriculture as a profession is that of pay. Even under government service amongst all the technical branches the scales of pay in agricultural service, specially that of the upper subordinate service, is about the lowest compared to those of others. Considering the hard life and the difficult conditions under which an agricultural graduate has to work there should be better inducement and greater compensation given by way of better pay than what is paid at present. In practice the lot of the agricultural graduates

who have to work in the open in the scorching sun or under other adverse weather conditions is quite dispiriting. The inequitableness of service conditions should be removed and an agricultural graduate should be paid on par with an engineering or medical graduate. If these disparities are removed and greater scope for employment as indicated above is provided there is a bright future for agricultural education which after all in any country forms the basis of all agricultural development and prosperity.

Section of Physiology

XXIV. TEACHING OF PHYSIOLOGY IN INDIA.

Chairman : DR. N. N. DAS (Calcutta)

1. DR. S. BANERJEE (Calcutta).

Study of Physiology in India in the present days.

Physiology is taught in Indian Universities both in the graduate and post-graduate levels. Physiology is studied in all the medical colleges of India as a part of the First M.B.B.S. course. In some of the affiliated colleges of the University of Calcutta, physiology is taught as one of the subjects for the degree of Bachelor of Science. In the University College of Science and in the Presidency College, which is a constituent college, under the University of Calcutta physiology is studied in the B.Sc. course as an honours subject and in the post-graduate level in the M.Sc. class. Both in the B.Sc. honours and in the M.Sc. classes physiology is studied for a period of two years. In the medical colleges physiology is studied in the First M.B.B.S. course for a period of two years. Physiology includes studies on histology, experimental physiology and physiological chemistry (biochemistry). While in some of the medical colleges of India the studies in all the branches of physiology are co-ordinated by the professor of physiology in others it is not so. Histology is studied along with anatomy in some of the medical colleges. Physiological chemistry is taught by a professor or reader of biochemistry in some of the colleges and the department is independent of the department of physiology. In these colleges experimental physiological studies on amphibian, mammalian and human physiology are imparted in the department of physiology. In the First M.B.B.S. course chemistry is a subject for study along with physiology and anatomy in some of the colleges. In some of the colleges only organic chemistry is studied and questions on organic chemistry are asked in question paper on physiology in the First M.B.B.S. examination. In other colleges chemistry is taught in the First M.B.B.S. course but the students are not examined on the subject. Authorities of some of the colleges have decided to abolish the studies on chemistry as a part of the First M.B.B.S. course. They are of opinion that a knowledge of chemistry is not essential for a medical student. In the post-graduate level students who have passed the Final M.B.B.S. examination are examined in physiology under the Faculty of Medicine for the M.Sc. or M.D. degrees in some of the medical colleges. The student works on a problem under a professor of physiology and submits a thesis and if the thesis is recommended then the student sits for a written, practical and viva-voci examination. No theoretical or practical classes are held for teaching physiology in the post-graduate level and the candidate is left to itself for his studies. In some of the universities no syllabus is prescribed for the post-graduate course in physiology. Outside the medical colleges physiology is studied in the post-graduate level as a basic science only in the University of Calcutta in the Presidency College and in the University College of

Science. There is a prescribed course of syllabus both for the theoretical and practical papers and regular classes are held for two years. Students, however, do not have a knowledge of anatomy and some of the students are admitted in the course who do not pass B.Sc. with chemistry as one of the subjects.

PROBLEM OF STUDIES IN PHYSIOLOGY IN THE MEDICAL COLLEGES

Chemistry as a subject in the First M.B.B.S.

To explain the various physiological processes in the body, the knowledge of chemistry is essential. Without a basic knowledge of organic and physical chemistry it is not possible for a student of physiology to understand the subject in the proper perspective. Chemistry, therefore, should be one of the subject in the First M.B.B.S. course. Students should be examined in chemistry because no students read a subject in which they are not examined. Tendency of medical politicians of India to remove chemistry from the curriculum of the First M.B.B.S. course should be resisted by all physiologist. Otherwise teaching of physiology will suffer greatly.

Duration of course of studies in First M.B.B.S.

The Indian medical council is going to diminish the duration of the course of studies in the First M.B.B.S. from two years to one year and a half in order to produce more doctors in a short period of time. I had a discussion with many professors of physiology in medical colleges. All of them were of opinion that it is not possible to finish the course of studies in physiology before two years. Country needs more doctors no doubt but without a basic knowledge of physiology efficiency of doctors will suffer greatly and every body will agree that the country needs efficient doctors.

Teaching of biochemistry as a subject independent of physiology.

In some of the medical colleges non-medical men without a knowledge of physiology are appointed to teach physiological chemistry. As a teacher of physiology I fail to understand how such a person can be an efficient teacher on the subject. Any physiologist who has read organic chemistry in the B.Sc. can teach physiological chemistry. Physiological chemistry should not be separated from general physiology. To explain general physiological principles chemistry of the processes must be told at the same time. Different teachers may be entrusted to teach different systems of physiology but chemistry of the different systems should be taught along with the individual systems. The tendency to disintegrate the studies of physiology is harmful and this should be resisted by all the teachers of physiology.

Study of histology under anatomy.

Histology is being studied along with physiology. In some of the medical colleges histology is now under anatomy. Anatomists argue that histology is minute anatomy and as such should be taught under anatomy. There is no harm if students read histology along with anatomy. Teaching of histology will not suffer in the hands of an anatomist. Students in the First M.B.B.S. course spend more time in anatomy than in physiology. The only difficulty which the anatomists will face is the time table for taking both the morbid and minute anatomy classes.

Pay of lecturers and demonstrators in physiology.

Lecturers and demonstrators in physiology in the medical colleges are very poorly paid and as such they have to depend on their private medical practice for extra income. They, therefore, cannot devote whole-hearted attention to their duties in the department. Unlike other clinical departments of medical colleges and the prospect of these teachers to earn more money by private practice is not very bright. As a result this department does not attract usually doctors with a good academic career. The attention of the authorities of medical colleges is, therefore, drawn to this fact with a request to increase the emoluments of teachers and demonstrators in physiology.

Post-graduate studies in physiology under the faculty of medicine.

According to the rules of the Indian Medical Council a teacher in a medical institution must possess a post-graduate degree in the subject he will teach. Doctors, therefore, try to obtain the M.Sc. or M.D. degree in physiology to become a professor or a lecturer in the subject. No proper teaching, however, is imparted on the subject in any of the medical colleges in India. The professor guides the student for his thesis which forms a part of the examination and for the second part of the examination the candidate is left to himself. No syllabus is prescribed and as such the candidate does not know what to read. This is a very unhappy state of affairs. In some of the Universities there is no post-graduate degree in physiology under the faculty of medicine. In the university of Calcutta a person who has passed Final M.B.B.S. examination is not allowed to read M.Sc. in Physiology unless he passes B.Sc. with physiology. Doctors of the University of Calcutta are, therefore, at a disadvantage as compared to doctors of other Indian universities. The attention of authorities concerned is drawn to these problems with a view to remedy the defects at an early date. Professors of physiology are requested to influence the authorities concerned to evolve a unified syllabus for post-graduate studies in physiology so that a standard is maintained in all the universities of India.

Study of physiology outside the medical colleges.

It has been said that physiology is taught in B.Sc. and M.Sc. classes in the University of Calcutta as a basic science outside a medical institution. The B.Sc. honours standard is higher than the First M.B.B.S. standard in physiology. The M.Sc. course is extensive and different branches of physiology including biochemistry are taught at a higher level. Only defect of the course is that students do not dissect a human body and do not read anatomy. If a paper on anatomy is included in the curriculum for M.Sc. the defect is rectified. As biochemistry is taught extensively along with physiology no student should be admitted in the course who does not pass B.Sc. with chemistry and physiology. In the B.Sc. human physiology should be one of the subjects for study along with anatomy. Students who will take up physiology, anatomy and chemistry in the B.Sc. should be admitted into the Final M.B.B.S. class after passing the B.Sc. examination. Physiology should be one of the subjects for the examination of the Indian Administrative Services. This will be an encouragement for students to take up physiology in the B.Sc. stage and authorities of colleges will open physiology departments for B.Sc. examination.

A few problems facing the teachers in physiology have been brought forward and some solutions have been suggested. I would request all the physiologists to consider the points raised and to evolve a solution in a better manner so that teaching of physiology is imparted in the best manner in the colleges, medical and non-medical, of India,

2. SRI P. B. SEN (Calcutta) : *The need of greater Orientation of Physiology with other basic Sciences.*

The science of physiology should receive a greater attention as a subject of general education; because it would help people to orient life to the changing patterns of social and physical environments. On this basis of general education, the physiologists may build up their specialized knowledge on the different aspects of the science. In such specialization, it is not desirable to limit the applicability of physiology, by adopting a narrow angle of vision. As an applied science, physiology would profit by a substantial knowledge in many of the basic sciences. We can hardly name any science which has no direct or indirect application in some aspects of physiology. We are also conscious that the problems of physiology has stimulated the development of other sister sciences. So in the brotherhood of sciences, physiology, is flourishing in a symbiotic coexistence. In the present stage of development, a physiologist is expected to know many sciences having application in physiology. So after the study of basic physiological principles it may be necessary for one to specialize in one of the aspects of physiology. Thus a physiologist may fit himself in many of the applied branches, such as, environmental physiology, industrial physiology aviation physiology, comparative physiology, bacterial physiology, physiological chemistry, biophysics, pharmacodynamics, and many other allied branches of study.

3. DR. B. NARAYANA (Patna) : *Teaching of Physiology in India.*

The subject of Physiology can be taught either in the Faculty of Science as a purely science subject or it can be taught in the Faculty of Medicine as a part of the medical curriculum. In India Physiology is being taught almost exclusively in the various medical colleges and very few science college have provided for the teaching of Physiology leading to the B.Sc. or M.Sc. degree. A science student learns Physiology as a purely science subject whereas a medical student thinks more of its application to the study of medicine. It is necessary that even a medical student should study the subject on a purely scientific basis if he has the desire to apply the physiological principles in his medical practice.

Physiology embraces Histology, Bio-Chemistry and Bio-Physics. There has been a serious attempt to take Histology to Anatomy and put Bio-Chemistry as a separate subject. There is no harm in having a department of Bio-Chemistry independent of the department of Physiology but there should be co-ordination in the teaching of Physiology and Bio-Chemistry at the undergraduate level. In a Medical College the teaching of Histology may be done either in the Department of Anatomy or in the Department of Physiology but any step taken in this direction should be done with the consent of the two departments and in the best interest of the students. In a Science College the teaching of Histology should continue to be done in the department of Physiology.

A degree course in Physiology should normally cover 2 years whether in a Science or in a Medical College. Apart from the systematic lectures, there should be—(a) tutorial classes with as few students in a group as possible, (b) Conferences in which the whole class could participate and discuss special subjects under the guidance of a senior teacher, and (c) practical classes. The practical classes should comprise human and mammalian Physiology as well.

A B.Sc. degree course with Physiology as one of the subjects should be provided for in more institutions and arrangements should also be made so that a medical student could take a B.Sc. Honours degree in Physiology within 2 to 5 years of his admission to the Medical College. A B.Sc. Honours degree in Physiology should lead to a Master's degree in the subject obtainable either by pure research or by a combination of research and regular instructions in the subject followed by examination. A B.Sc. pass degree, on the other hand, should not lead to the

M.Sc. degree by pure research. In a Medical College, the teaching of Anatomy, Histology, Physiology, Bio-Chemistry and Bio-Physics should be integrated as far as possible and when this is done it is immaterial whether Histology is taught with Anatomy or Physiology and whether the Department of Bio-Chemistry is independent or a part of Physiology.

4. DR. S. K. DATTA (Calcutta) : *Teaching of Physiology in India.*

Physiology is a highly complex science and it is applied in nature. Complete understanding of the life process is far beyond the limit of human knowledge.

Physiology was treated as one of the major subjects in the medical course. But its separate study with fundamental knowledge in other basic science is essential.

Physiology has not received proper appreciation due to many factors. Want of balance among teachings, researches, and the applications is keenly felt. Role of physiologists in the social life is also an important factor. Co-operation of the state for the development of this applied science will be helpful.

The change in the outlook of the teachers of physiology seems also to be required.

Proper application of physiology should provide suitable employments for young physiologists.

Progress of this applied science should help the development of India.

5. SRI J. N. MUKHERJEE (Calcutta) :

In India, the subject of Physiology is being taught mainly in the medical curriculum and partly in the general scientific curriculum. The study of Medical Physiology is based on preliminary and general principles of the subject. The medical students do not think deeper into the fundamental growth of the subject. They may never have an opportunity to think further on this subject than to apply the crammed formulae.

On the contrary, Physiology as a basic science subject is being taught in such a way that the student is expected to find out newer facts which are still unrevealed. For this, there must be ample scope of study and research and encouragement to the students of this basic science subject.

It is unfortunate that in India, the authority is being influenced by the medical Physiologists who have a limited outlook on this subject.

I may put my appeal to the Physiologists of India that we should try to establish our own status so that we may not remain in the future as dolls in the hands of those medical men, otherwise the growing scientific spirit in the minds of Physiologists of India will be nipped in the bud.

I have experienced another difficulty amongst the B.Sc. students: they have very little idea of the macroscopical structure of the body. This problem may be solved by making a suitable arrangement with the medical college for the dissection of one body in three months time and setting one compulsory question on macroscopical anatomy in the University question paper.

I also express my earnest desire that a provision be made for the medical graduates to study the M.Sc. Physiology if they desire, without appearing for the B.Sc. examinations. Those medical graduates who are really keen to be Physiologists, must have this facility.

6. DR. J. D. PATHAK (Baroda) :

The premedical curriculum should be so arranged that organic chemistry etc. has not to be repeated in the medical college. This would save a good amount of burden of the Physiology courses.

A co-ordinated course not only between the various disciplines of Physiology—biochemistry, nutrition, histology necessary but the course should be arranged and well co-ordinated with even the other departments—as anatomy. There is a great tendency to deal with the subject in a compartmental way. This is not correct. The human being should be considered as a whole. In teaching the various chapters, anatomists, pharmacologists, physicians and others should be brought in the same class-room to teach them speciality. Arrangements for symposia will not only impart the subject better but will save considerable amount of overlapping and what is more—the standard of teaching will considerably improve.

The teaching of Physiology should not end at the I M.B.B.S. examination. The students should be taught by Physiologists the various aspects of applied Physiology throughout the clinical years.

In the Medical Colleges greater emphasis needs to be paid on the clinical-medical aspect of the subject and it is a high time now that Human Physiology exercises should be introduced in the courses.

XXV. INTERRELATION OF PROTEIN AND VITAMINS.

Chairman : DR. N. N. DAS (Calcutta).

1. DR. B. MUKERJI (Lucknow) :

Since the discovery of "yellow oxidation enzymes" by Warburg in 1932 and subsequent evidence that riboflavin is a component of this enzyme a new chapter has been opened up and lot of interests have been created in carrying out investigations to evaluate the relationship between vitamins and enzymes. These resulted in the further discovery that nicotinic acidamide, riboflavin and thiamin are the main components of a number of co-enzymes. These enzymes after combination with a specific protein or enzyme are capable of being alternately reduced and oxidised and in this way transference of hydrogen from a substrate to a final oxidising agent takes place. The nutritional effect of the vitamins already mentioned is directly related to their known roles in enzymic behaviour.

Since the vitamins maintain animal life, they may, as part of their action influence secretions of the organism. Thus a relation of vitamins to hormones though not *a priori* is not illogical. It can be generally observed that in animals which have been deprived of vitamins for a long period, not only the entire organism suffers but that particularly the glands lose vitality resulting in the decrease of the effective secretions.

In addition to the general effect of vitamins on the secretion of hormones, there has been synergism and antagonism of vitamins to hormones. Thus there is what has been interpreted as a synergism between vitamin C and the hormones of the adrenal medulla and cortex. An antagonism between Vitamin C and the thyroid hormone has been postulated. There are several interesting observations on the relationship of various vitamins and hormones of pancreas, thyroid, sex organs, parathyroid and adrenal glands, which will be discussed. Much ground remains to be covered in this field of study.

2. DR. G. C. ESH (Calcutta) : *Protein metabolism and Vitamin B-complex with special reference to Vitamin B₁₂.*

For normal protein metabolism various B-complex vitamins are needed in adequate concentrations. Presumably these vitamins act in enzymatic fashions in promoting protein synthesis. Amino acids may be converted to vitamins. The outstanding example of this is tryptophan which can serve as precursor of niacin. The interconversion of methionine and choline under certain dietary conditions

is too well known. Again the dietary intake of protein is a factor which influences the requirement and metabolism of certain members of the B-complex. Animals ingesting diets low in protein are incapable of retaining riboflavin and nicotinic acid efficiently and of maintaining tissue concentrations of them. The requirement of vitamin B₆ is increased when animals are fed high protein diets. Due to its lack tryptophan metabolism is deranged and an abnormal metabolite xanthurenic acid appears in the urine. Pantothenic acid deficiency is less readily induced when a high protein diet in contrast to a normal protein diet is given. Thus for the maintenance of normal tissue concentrations of the factors like vitamin B₁₂, niacin, biotin, folic acid, B₆ and pantothenic acid an adequate protein intake is necessary.

Both folic acid and vitamin B₁₂ take part in protein utilization not only for hemopoiesis but also for growth and development. Experiments have been reported showing the influence of B₁₂ in increasing the digestibility and biological value of casein and soyabean protein. Recently the author has observed in the Bengal Immunity Research Institute that vitamin B₁₂ not only enhances the digestibility and biological value of vegetable proteins like pulse protein but it also significantly increases the growth promoting value of such proteins particularly when the animals are fed at high levels. Experiments with rats and chicks have indicated that B₁₂ is concerned in transmethylation processes particularly those involving methionine formation. It has been suggested therefore, that B₁₂ aids the methylation of homocysteine by promoting the synthesis of methyl groups available for use in the synthesis of methionine from homocystine. Thus animals can utilise certain amino acids (serine and glycine) as sources of the methyl group of methionine synthesis when B₁₂ is supplied.

B₁₂ is related to the genesis of nucleic acid in liver cells. The increase of PNA in the liver, spinal cord and cervical sympathetic ganglia after parenteral administration of B₁₂ to deficient rats has been demonstrated. Plasma protein of B₁₂ supplemented chicks was found significantly higher than that of deficient chicks. It seems possible that B₁₂ functions in protein metabolism by stimulating formation of ribonucleoproteins and plasma proteins. Various experiments tend to indicate that B₁₂ can decrease the loss of nitrogen resulting from the catabolic action of thyroxine. The results suggest that in hyperthyroid rats vitamin B₁₂ spares protein at the expense of other body constituents. It is however, interesting to note that B₁₂ has no influence on cortisone induced protein catabolism.

3. SRI P. B. SEN (Calcutta): *The effect of high protein diet on the development of scurvy.*

Ascorbic acid has been found to play a considerable role in the protein metabolism, particularly in respect to the aromatic amino acids. Studies on the excretion of alpha amino nitrogen in urine suggests that other amino acids are also involved in the deficiency of vitamin C. In this condition, some of the enzymatic processes that are linked with protein metabolism are also directly or indirectly affected. Ammonia/urea ratio in urine is also increased during scurvy.

Level of protein in diet has some influence on all these factors and on the development of scurvy. The survival period of scorbutic guinea-pigs is diminished under heavy protein load, which is also associated with an appreciable increase in the excretion of vitamin C in urine. High level of protein in diet acts as a stressor, producing a marked hypertrophy of the adrenal gland. The adrenal ascorbic acid is relatively diminished in scorbutic animals, especially in those that are kept in high protein diet.

The basal oxygen consumption in guinea pigs is increased as the protein level in the diet is raised. This stimulus to the basal oxygen consumption is

absent in scorbutic guinea pigs, where different patterns of fluctuations are observed during the progress of scurvy, associated with high protein diet. The specific dynamic action of protein in different levels of intake is manifested by a characteristic pattern having a definite time lag.

4. DR. P. S. SARMA (Madras) :

Two aspects of the fascinating study of Inter-relation of Vitamins and proteins will be presented, one dealing with the protein transformation during germination investigated with anti-vitamins and the other on the influence of protein hydrolysates on the biological synthesis of nicotinic acid from tryptophane. Dealing with the first aspect it is well known that during germination of seeds, there is a rapid breakdown of the reserve proteins into the constituent amino acids followed by synthesis of the protoplasmic proteins of plants. Our investigation with the antivitamin, neopyrithiamine has led to the establishment of a conversion of glutamic acid to aspartic acid and the participation of thiamine in these transformations in green gram (*Phaseolus mungo*) seedlings. Evidence has also been obtained for such participation by tracer technique by the use of radioactive glutamic acid and radioactive glucose.

In regard to the influence of proteins and protein hydrolysates, on tryptophane nicotinic acid inter-relationship, it was at first thought that the proteins like gelatin or casein or their hydrolysates influenced the intestinal flora of the animals and thereby altered the nicotinic acid requirement. Work in this department carried out with the nicotinic acid dependant strain of *Neurospora Crassa*, showed that the utilization of tryptophan, formyl kynurenine, kynurenine and 3-hydroxy kynurenine were affected when protein hydrolysates were present in medium and that the utilization of 3-hydroxy anthranilic acid and nicotinic acid were not at all affected. It was also observed that the activity of the enzyme 'Kynureninase' was depressed by protein hydrolysates as well as certain specific amino acids.

5. DR. D. P. SADHU (Calcutta) :

Metabolism of proteins is controlled to a great extent by some vitamins, usually with the help of hormones. These vitamins form a part of the enzyme systems in general which mediate protein metabolism. Vitamin A forms a protein complex of rhodopsin and porphyropsin, necessary for normal visual functions. It also decreases Specific dynamic action of protein (SDA) indirectly by acting on thyroid. Vitamin E decreases creatinuria of children after glycine administration and has also a general regulatory influence on energy metabolism. Pyridoxine as pyridoxal or pyridoxamine phosphate acts as a co-transaminase and catalyses transamination reactions and thus reduces SDA, while its deficiency increases SDA (Sadhu). It also helps in decarboxylation of certain amino acids as a decarboxylase and mediates the conversion of tryptophan into nicotinic acid and N'-methyl-nicotinamide. It is also responsible for gluconeogenesis from amino acids.

6. SRI J. N. MUKHERJEE (Calcutta) : *Relation of Vitamin-E with the muscle dystrophy.*

The dystrophy of muscle have been observed in the animals, fed on vitamin-E deficient diet. Milman *et al*, have shown that loss of muscle protein in vit-E deficiency cannot be explained by an increase in the rate of breakdown of protein in the muscle.

I have observed *in-vitro* experiment that there is considerably low protein absorption in the isolated intestine from the vit-E deficient diet. This considerably

low absorption of protein in the intestinal canal might be one of the factors responsible for the dystrophy of the muscle.

7. DR. S. N. RAY (Izatnagar) :

In guinea pigs, fed dessicated thyroid, the requirement of vitamin C for the preservation of tooth structure is thrice than that for control animals. In rats, dessicated thyroid feeding does not affect the ascorbic acid content of either liver or the suprarenals, but the content of the vitamin in the kidney is greatly reduced. It is suggested that heightened protein metabolism leads to large formation of ammonia which leaches out ascorbic acid from the kidneys. Increasing the body temperature by exposing animals to the direct sun light also leads to a lowering of vitamin C in the blood serum.

In cobalt deficient sheep the nitrogen balance is negative. When cobalt is administered, the balance becomes positive within a few days. As vitamin B₁₂ injection alone can cure cobalt deficiency most probably this vitamin is concerned with effective protein utilization and storage.

8. DR. SHIVKUMAR (Amritsar) :

(1) Intimately related to the metabolism of Ribonucleo-proteins, the formation of Plasma proteins apart from its effect on myoblation of Haematopoiesis, is agreed Cobalamine or Vitamin B₁₂. Some of its metabolic functions included, the utilization of one carbon compounds generation and transfer of methyl groups, and regeneration—S-S—groups into the function—SH groups of enzymes as in Acet Co enz. A etc., of the 'prolation' groups of glutathione (reduced). Vitamin B₁₂ influences protein utilization and nitrogen retention. The protector influence of Proteins (containing SH-groups) and their influence on Haematopoiesis and protection of macrocytosis was discussed by the author in relation to his own work.

(2) Apart from its role in the fat metabolism the pyridoxal group of B-Vitamins (B₆) has its primary catalytic role in the metabolic reactions of aminoacids. It is now recognised that this group functions as a coenzyme in transamination reactions, desulphydration of Sulphur aminoacids, dehydration of hydroxy-amino-acids, decarboxylation of aminoacids, racemization of amino-acids, as a cofactor aminoacid reactions. Thus it would seem to be intimately related with metabolism and utilization of proteins and the constituent aminoacids.

(3) Indirectly related to the metabolism of Proteins, on account of its role in the transacetylation reactions and initiation of Wrehl's tricarboxylic acid cycle—a source of energy—is the Pantothenic acid—SH group containing Acetyl coenzyme A. The antibody titre decreases in Pantothenic acid deficiency.

Section of Psychology and Educational Sciences

XXVI. PSYCHOLOGICAL RESEARCH IN INDIA—ITS PAST, PRESENT AND FUTURE.

Chairman : DR. RAJ NARAIN (Lucknow).

1. DR. PANDHARINATH PRABHU (Bombay) : *Current Psychological Research in India.*

A survey of the research recently completed and currently engaging the attention of psychologists in India is taken, and an analysis with a view to locating the general trends of such research is made. An attempt is made to find out if the causes of these trends are peculiar to Indian conditions. Some suggestions for new directions of research are also discussed.

2. DR. (MRS.) K. CHOWDHRY (Ahmedabad) : *Research in Industrial Psychology in India.*

In India it can be safely said that the use of Psychology in Industry started after World War II. Even now the use of psychologists is very limited in Industry, but there are indications of their being wanted in larger numbers by different industries.

The organisations doing research in the field of Industrial Psychology are very few. There are Applied Psychology sections of the Universities, Research Organisations connected with the Industry, and Personnel and Industrial Relations Departments of some individual firms.

In this paper a brief history of the development of Industrial Psychology in India and the broad scope of work being undertaken by some of the major Universities and individual firms are given. The main emphasis of the paper is on the development and the growth of the Psychology Department of the Ahmedabad Textile Industry's Research Association. The beginnings of the Department, the policies in the selection of research problems, the factors connected with the selection of research personnel in ATIRA as well as in the mills, the nature of implementation in the mills etc., are discussed. Research problems that have jointly been undertaken with Indian Council of Medical Research, Calcutta, the Social Research Institute of the University of Michigan, Ann Arbor, the Industrial Relations Department of MIT, and the I.L.O., Geneva, have also been discussed.

A brief account of Industrial Psychology work in Tata Industries in the Sarabhai concerns, in Ahmedabad and Bombay and in the Delhi Cloth Mills, has also been given.

3. (MRS.) P. PHATAK (Baroda) :

The paper specially deals with psychological research in the field of Education in the State of Bombay.

Psychological research in India is a young child and has not much of solid history. Since about a decade and half the interest in psychological research is spreading fast.

Most of the workers at the initial stage were those who have studied in England. The work they did was either repetition of the same or similar experiments that they might have done or observed in England. To-day many students take up psychological research with the intention of getting some degree. A tendency is observed to apply the variety of tests published in English to Indian students. Some times the test is translated and adapted into a regional language. Similarly, a lack of sustained interest in a particular research through some binding force is also felt.

An attempt is made to show how even the comparatively culture free tests require proper study and modifications before accepting them for a particular environment.

4. DR. K. C. MOOKERJEE (Calcutta) : *The role of Psychologist in the Treatment of Mentally-ill Persons.*

A properly trained psychologist can render most valuable service at all stages in the treatment of mentally-ill persons. Such of the services which have been recognised on all hands as most useful can be summarised as follows :—

1. In History taking—detailed history from psychological standpoint—should begin from early infancy and end with the first signs of mental break down—no period of life should be left unaccounted for—all relevant information should be patiently gathered.

2. In Investigation—psychometric tests—psychodiagnostic investigations so as to reveal the mental contents and the circumstances for the failure of normal adjustments.
3. In Treatment proper—can render valuable aid in the treatment itself by supplementing with psychological services of either supportive or analytic type—in certain types of mental disorders adjustments in the psychological plain is all that is needed to effect a cure. •
4. In the task of rehabilitation, the role of clinical psychologist can be hardly over-emphasized. Being in possession of important knowledge concerning the mental make-up of the patient the psychologist can confidently proceed with the work of rebuilding the home environment to make it less trying and more congenial for the patient to live in.

5. MR. S. M. MOHSIN : *Training of Psychologists as Scientists.*

A. *Planning the Courses of Studies* : Unnecessary duplication is generally found in the courses from one stage to another. This should be avoided. The undergraduate course should provide a broad-based training in the fundamentals of the science. The post-graduate and Honours courses should provide a more intensive and specialised training. The specialization is to be effected through the grouping of closely allied branches.

At every stage, the courses should be planned keeping in view their usefulness in future training or life.

B. *Teaching* : (a) The scientific status of psychology. The use of the laboratory in teaching theoretical psychology. The use of the clinic in teaching theoretical psychology. Need for greater stress on physiology and statistics. (b) Laboratory work. Its aim not mere mechanical performance of some stock experiments, but training in scientific method for conducting independently original investigation and research. Suggestions are made for materialising this objective.

6. PROF. V. K. KOTHIURKAR (Poona) : *Research in Social Psychology in India.*

According to O. L. Zangwill, Social Psychology is still largely 'a hope of a science—a dream—rather than an accomplished fact'. Any way, it has had a very brief history abroad and briefer still in India, though it promises to have a great future. The impact of Independence and the terrific out-break of the post-partition hostilities together with their aftermath viz. vast numbers of displaced persons roaming over the land, brought home to our people and our Government the existence of vast areas of acute social tensions and the most violent forms of communal prejudice. It was in this context that research in Social Psychology in India had its brilliant beginning in 1950 with our Government requesting Dr. Gardner Murphy to plan and organize research in social tensions in the various parts of our country. Indian participation in the UNESCO Tensions Project. Work of the six official and some non-official research teams on the three cornered hostilities between Hindus, Hindu refugees and Muslims, together with the intricate pattern of caste-prejudices.

Two-fold radiation effect of the original research impulse and activity :

1. Not only a few active, continuing, creative centres of social research were established, but, other centres were presently drawn into the movement so that Psychology Departments nearly all over the country started functioning along this line.
2. Secondly, the techniques and methods tested and tried out in the field of group prejudice, hostility and general tension research are being adapted and applied to other larger areas like rural research. This is a healthy tendency in an agricultural country like ours and may result in an accumulation of a sizable body of knowledge regarding the procedure and principles of rural Psychology. Periodic publications of the Programme Evaluation Organization of the Planning

Commission like "Group Dynamics in a North-Indian Village—A study of factions" by Oscar Lewis (1954) or "Community Projects—First Reactions" (August 1954) are worth mentioning.

Statistical analysis of published and unpublished research papers in social Psychology in India. Inadequate facilities for reporting the results.

The general tendency of these papers is to give a surface description of some of our backward tribes (in the Anthropological approach) or to give the bare content of prevailing stereotypes, rumours etc. (in the psychological approach).

More significant research in Social Psychology in India must, in future, take the line of deeper dynamic analysis, interpretation and explanation of group behaviour and social relations.

7. MR. ABDUL HAFEEZ (Mysore) : *Research in Experimental Psychology in the Mysore Laboratory.*

The laboratory was started in the year 1924 with Dr. M. V. Gopalaswamy, B.A., B.Sc. (Lond.), Ph.D. (Lond.), as Professor. He conducted and directed research of his students and associates on a number of topics including Child Psychology, Experimental Aesthetics, Crime, Intelligence, Personality, Values and Para-Psychology.

Dr. B. Kuppaswami, M.A., D.Litt., Professor of Psychology (Mysore) did research on the "Inheritance of habits" and has been constantly contributing a series of papers to the various journals and other learned bodies on topics like Intelligence, Child Behaviour, Group tensions, and Rorschach. Researches carried out in this laboratory among others include the following :—

1. A Study of Juvenile offenders.
2. Speed of Correlate Education.
3. Estimation of Character and Personality through P.G.R.
4. A study of twin resemblances and differences.
5. The development of fear, anger and laughter in Children.
6. The Psychogalvanic technique of Crime Detection.
7. Personality Types.
8. Psychology from the standpoint of Sri Sankara.
9. An experimental study of the Development of sense of values.
10. Measurement of Psychic Energy.
11. Psychokinesis.
12. Language Development of the Preschool Child.

8. DR. D. MISRA (Parlakinedi) : *Relation between Philosophy and Psychology.*

1. The emancipation of Psychology from Philosophy has to be accepted as a fact; what is necessary is a change of attitude.

2. Psychological problems in the various phases of organic behaviour have to be approached strictly from the scientific point of view; no more of speculation.

3. Experimental approach—prerequisites of some training in Physics, Chemistry and General Biology have to be satisfied; a bit of Physiology and Biochemistry do constitute parts of Psychology; Mathematics essential for Statistics and computation of experimental data ought to be there also.

4. Considering the special problems of this country, particularly lack of statistical data with regard to intelligence and aptitudes, Statistics in Psychology and Education ought to be compulsory for every student of Psychology and for the advanced students of education.

5. Psycho-technological branches in the light of the growing industrialisation of the country should be opened in every university and courses in Vocational counselling and guidance ought to be provided in every training college with pro-

vision for the appointment of a vocational counsellor in every high school (more details to be discussed).

6. Provision of a comprehensive training at the Intermediate and the Degree stages (more details about the courses of studies to be discussed).

7. History of Psychology or Systematic Psychology should be a brief course at the Degree and a more comprehensive course at the post-graduate stage.

8. Introduction of Animal Laboratories (reasons for this to be discussed in detail).

9. Completely autonomous departments of Psychology in Colleges and Universities with all that a department requires (details of organisation and administration to be discussed).

Discussions will include the necessity for a change of attitude, the psychological attitude, courses of studies, different levels of departmental organisation and administration, teachers, prerequisites to be satisfied by the students, specific problems, which we have not yet approached, and which are arising as a result of the gradual industrialisation, reorganisation of Training Colleges, teaching of Education as a subject on psychological lines, psychological research and laboratory organisation and above all development of Psycho-technology in the application of Psychology to industry, medicine and problems of social upliftment.

XXVII. CRIME AND SOCIETY.

(Chairman : DR. RAJ NARAIN (Lucknow).)

1. DR. NIROD MUKERJI (Ganhati) :

'Delinquency is not a social science concept but essentially a legal one'. Nevertheless its intricate bearing on the psychosocial aspects of the man makes it an important subject for closer scrutiny. The disproportionate rise in the delinquency, particularly among the juveniles, in almost all the civilized countries in the recent days impels us to seek for the causative factors more closely. Owing to the fact that foundation of the schema of personality is laid down during the early life of the individual, juvenile delinquency would naturally occupy a larger sector in any such study. That is why this paper mainly deals with delinquency during the preadolescent stage.

It is now generally admitted that any investigation on this subject to be fruitful should seek for the aetiological factors in the social sphere. An attempt therefore has been made in the present paper to determine some of the positively determining factors in the young delinquents, facts regarding which have lately been collected by the police of the district of Calcutta. Unemployment among the able-bodied youth, when it is desirous of keeping itself engaged in fulfilling social obligations appears to be one factor which needs be heavily underlined in pointing to the manifold causative factors.

2. DR. R. C. NIGAM (Jaipur) : *Crime and Society in Ancient India.*

In this paper it is proposed to study only one aspect of crime in the Ancient Indian Society, viz., principles of administration of Criminal Law.

The Criminal Law of a nation is a mirror or true index of its culture and civilisation. The principles of administration of Criminal Law in Ancient India will, therefore, give us an insight into the civilisation and culture of the Ancient Indian Society.

(a) *Sources.*

The sources of our study are very meagre and are hardly to be found in written records until we come to *Arthashastra* of Kautilya, *Manusmriti* and *Yajurveda*, which cover, more or less, six centuries of Ancient India, viz., 300 B.C. to 300 A.D. This paper is mostly based on the above three leading Law Codes of Ancient India.

(b) *Danda or Punishment.*

The foremost duty of the King in Ancient India was to protect his subjects and to see that the rules of *Varnashrama Dharma* or the established order of Society were obeyed by his subjects and to punish the wicked and to dispense justice. The King carried out his duty through *Danda* or punishment, which was deified or personified as the Ruler in order to stress its deterrent force.

(c) *Purpose of Punishment.*

The purpose of punishment was primarily deterrent, while prevention, correction and purification occupied only a secondary place. But it was not retaliatory as *Jus Talionis* was not known to the Hindu penologist.

(d) *Principle of Individualisation of Punishment.*

The Hindus law-givers knew full well that the true measure of punishment depended on the nature of the crime, its magnitude, the character, status, education, in short, the individuality of the offender, as also upon the status of the injured and the value of the thing offended against.

(e) *Principles of detection and prevention of crime.*

The ancient Hindu administrators had an organised police system and had fully developed Criminal Investigation Department. They had developed elaborate principles for the detection of various offences and had also prescribed preventive measures in order to maintain peace and order in the Society. Persons were apprehended on suspicion of being notorious bad characters or having no ostensible means of livelihood. Nobody could sell or purchase second-hand articles without the sanction of the district authorities. Curfew was clamped at night time to prevent commission of offences.

(f) *Prerogative of Pardon.*

The King had the prerogative to grant pardon, reprieve or remission of punishment to the prisoners except those convicted of *Sahasa* offences and habitual offenders.

All the aforesaid principles of administration of Criminal Law are well borne out by the texts of the leading Law Codes of Ancient India. Such a coherent, scientific and systematic Criminal Law necessarily presupposes the existence of a well organised Society.

3. PROF. NIRMAL KUMAR BOSE (Calcutta) :

The concept of crime in any society is relative to the values which exist in that society. Ideas about property, about the ideals of sexual behaviour differ widely from tribe to tribe, and when there is a breach, the emotional reaction against transgression may also vary widely from one group to another. On a comparison between different civilization, we fail to reach any common elements in regard to the concept of crime all through the world. As has been said, it is relative to the values current in a society at any given point of time.

In regard to a single cultural group, the concept of right or wrong may also vary widely from one point of time to another.

When a social group is changing over from one economic or ideological condition into another, certain acts which might have been looked upon with disapproval may gain approval in course of time. What was formerly considered sinful might be regarded as criminal in course of time, and even that sting might be lost when the values of the particular society change still further.

Under these circumstances, any individual who deviates from the pattern of behaviour set for the time being, should be looked upon with greater* personal consideration; because of the fact that our concept of crime is itself subject to constant change.

SCIENCE AND ITS SOCIAL RELATIONS

Being two lectures delivered by J. M. Sen in December 1954 in the University of Calcutta and which formed the basis of a Symposium held at Baroda Session of the Indian Science Congress on 7th January, 1955.*

The subject 'Science and Its Social Relations' is a vast one and it is not possible for me to deal adequately with many aspects of the application of science for the betterment of the humanity. I therefore propose to give a brief resumé of the subject as it appears to me relevant for a discussion.

In December 1943, Sir J. C. Ghosh in his address to the National Institute of Sciences of India at Delhi, stated—"Men of science by training and instinct are averse to wasting their breath over might-have-beens; it is the present and the future that interest them more than past". Indeed this is true. The scientists who discovered Penicillin and anti-biotics or the insecticides like the D.D.T., the biochemists who synthesised Hormones, the engineers who discovered the structural applications of magnesium alloys particularly in aircraft, portable equipment and tools, the scientists who contributed their quota to the human progress by use of electronic devices to which we owe modern telegraphy, wireless, television, radio location, talking pictures, picture transmission by wire and wireless, the scientists who analysed and synthesised proteins and gave a new interpretation as regards the machineries of life, and those modern alchemists who discovered tools for smashing atoms and for use of atomic energy, are men who understood the needs of the present generation of human beings and they gave a new value to the life and social well-being of the community as a whole.

Science, ever since the time of the Arabs, has had two functions : (1) to enable us to know things, and (2) to enable us to do things. The Greeks, with the exception of Archimedes, were only interested in the first of these. They had much curiosity about the world, but, since civilized people lived comfortably on slave labour, they had no interest in technique. The Arabs wished to discover the philosopher's stone, the elixir of life—they discovered many facts in chemistry, but they did not arrive at any valid and important general laws and their technique remained elementary. In the late middle ages two discoveries were made which had a profound importance; they were the mariner's compass and gunpowder. It is not known who made these discoveries. The mariner's compass made possible the age of discovery. The New World was opened; the route to East round the Cape of Good Hope made possible the conquest of India, and brought important contacts between Europe and China. The importance of sea power was enormously increased, and through sea power Western Europe came to dominate the world. It is only in the present century that this domination has come to an end. Nothing of equal importance occurred in the way of new scientific technique until the age of steam and industrial revolution. The dis-

* Taraprosad Khaitan Lectures.

covery of gunpowder which is now used for blasting rocks and hard substances while constructing roads and tunnels, enabled men for years in subduing rebellions and in waging wars practically all over the world. It has also created the terrible problems of our time, viz. *war, technology in preparation for war, and nationalism* in almost all countries of the world.

In his Rushton Lectures on "Education and World Tragedy" Dean Howard Jones has tried to show how far the present system of education has created the above mentioned terrible problems of our time. Retaining the normal idealism of western civilization as a standard of measurement, if any human being tries to discover what has happened to mankind in the last fifty years such a person would be overwhelmed by a single tragic conviction; namely that the history of mankind for the last half century has been a history of deepening horror. The first half of the twentieth century is over. And what do we find? Since 1899, the earth has scarcely known a year without warfare, armed revolt, massacre, pogrom or other ingenious form of slaughter. These fifty years include two infernal conflicts—World War I and World War II. They include such disastrous struggles as the Boer War of 1899-1902, the Russo-Japanese War of 1904-05, the two Balkan Wars of 1912-13, the innumerable wars, revolts, 'interventions' and massacres in Finland, the Caucasus, the Ukraine, Poland, Hungary, Manchuria, Siberia, and other border areas, which followed the Bolshevik Revolution of 1917. They include the long drawn out agony of China, which beginning with the massacre of garrison troops in 1917, continued till 1949. They include the intermittent civil war in Spain. These are the major events.

But there are the other episodes, tragic in their time, viz. the Cretan massacre during the last two years of the nineteenth century (1899-1900), when the Christians slaughtered the Moslem peasantry; the Boxer rebellion of 1900; the Philippine insurrection and the 'water-cure', the massacre of a million Armenians between 1899 and 1919. The year 1922 saw the Irish Civil War in full swing, and there were Black and Tan outrages. The year opened with the slaughter of Greek civilians in Samsun—more than one hundred thousand Greeks had been killed and the climax of 1922 was reached at the taking of Smyrna, when an estimated 200,000 Christians were rendered homeless and the city was given over to pillage, rapine, massacre and fire. There was an earlier Graeco-Turkish war in 1897-98, and an Italo-Turkish war in 1911. Between 1928 and 1935, Bolivia and Paraguay fought to exhaustion over the possession of a tropical jungle. Indeed, during most of these fifty years there have been rebellions in Latin America.

The half century has seen armed rebellion sweep through such famous capitals as Paris, Berlin, Madrid, Athens and Rome. It has seen more or less protracted revolutionary struggles in Russia, Mexico, Spain, France, Germany, Hungary, Austria, Greece, Egypt, Iran, Palestine and other Arabian States, Mongolia, China and various other countries, besides what uncounted minor uprisings—in Nicaragua, Haiti, Albania, Thailand and the like—only the World Almanac tells us. India has experienced a full blast of atrocities in Calcutta and Noakhali in 1946, throughout the Punjab in 1947, and in Kashmir in 1948. Ours is a sick age.

How many human beings have been killed directly or indirectly in the course of this terrible history? It is almost impossible to find out. For example, we do not know and probably shall never know how many hundreds of thousands have died of violence in Asia and Africa during the last fifty years. How many perished during the obscure struggle for the control of Tannu-Tuwa, a country as big as Great Britain, lying between Mongolia and Siberia? How many Koreans were slaughtered by their Japanese overlords? How many natives of Congo died during the struggle for the control of the Belgian Congo? We do not know how many hundreds of thousands died in Russia, or in neighbouring states during the terrible convulsions that swept over the future Soviet Union between 1914 and the adoption of the constitution of

1915. We do not know how many millions Hitler and his agents killed.—But what we know with rough accuracy is sufficiently appalling.

Before 1900, about 25 per cent of all battle casualties died; in World War I this increased to 33¼ per cent. Out of every thousand Europeans alive in the twelfth century it is thought that two died as battle casualties; in the first twenty-five years of the twentieth century 54 out of every thousand so died. Professor Pitirim Sorokin estimates that during the first third of the twentieth century Europe alone suffered 24 million war casualties. From the eleventh century to the end of the nineteenth century war casualties totalled about 18 million. Therefore in the first three decades of the present century 33¼ per cent more human beings were killed in war in Europe than were killed in the previous 800 years. These figures do not include four other continents and they take us only to the rise of Hitler. Influenza, typhus, starvation, and other destroying agencies killed millions more. It has been estimated that 40 million of world population died, directly or indirectly, in World War I. We do not yet know the figures for World War II. The Japanese dead alone are reckoned at more than three million. The science reporter of the New York Times was thought in 1945, to have written a singularly effective masterpiece about the rare beauty of the atomic bomb upheaval over Hiroshima. This killed or mutilated 150,000 human beings, 30,000 so completely that no trace of them remains. A United Press dispatch from the Vatican in November 1945, estimated the dead, military and civilian, in World War II at over 22 million, and the wounded at 34 million, i.e. 56 million casualties in all.

While this blind struggle continues it increases its ferocity. Through the mouth of Satan in *The Mysterious Stranger*, Mark Twain sardonically remarks, "No brute ever does a cruel thing—that is the monopoly of those with the Moral Sense." Millions (nearly 100 million) who died, directly or indirectly in the two World Wars are at peace. Unnumbered thousands of human beings whose lives have been wrecked by war or starvation or despair or disease still exist. Regarding the long range results of war upon our lives Professor Quincy Wright tells us:—"Closely related to the racial (i.e. human) cost of war but less susceptible to objective measurement are the social and cultural costs of war in the deterioration of standards. Wars of large magnitude have been followed by anti-intellectual movements in art, literature and philosophy; by waves of crime, sexual license, suicide, venereal disease, delinquent youth; by class, racial and religious intolerance; by persecution, refugees, social and political revolution; by abandonment of orderly processes for settling disputes and changing law; and by a decline in respect for international law and treaties." The standards of only a few, he says, are elevated by war, a minor gain which by contrast deepens the gloom of the general picture. The coarsening effects upon our finer sensibilities of an uninterrupted series of wars, revolutions and bloodsheds have been such that people merely read them as ordinary news in the newspapers and then turn to the sports pages. So deep have we descended into the pit of insensibility that Dr. Irving Langmuir, Nobel Prize winner, physical chemist and associate Director of the General Electric Research Laboratories, solemnly warned a joint meeting of the American Philosophical Society and the National Academy of Sciences in the autumn of 1945 in Philadelphia that "so-called atomic warfare, unless the release of nuclear energy is controlled by the world, may make the entire earth uninhabitable wiping out the ignoble race of men." Dr. Langmuir is a conservative scientist. He spoke sadly and seriously. But the Americans do not believe things like this because they, and possibly people all over the world, do not wish to believe them.

Dr. Langmuir's statement suggests a second basic fact in this brutal history. It is that *modern warfare is increasingly a function of education*, and education is increasingly dominated by war. We do not like to think that this is so. We try desperately to deceive ourselves. One form of optimistic rationalization is the "progress" fallacy. The progress fallacy assumes that mankind always survives any

conceivable weapon. Another fact to be observed in this strange, eventful history is to note how nationalism increasingly invades education. The eighteenth century was perhaps the last period when a truly international culture was the common object of study, at least among the cultivated classes in the western world. Till then education was not customarily created or paid for by the state. Throughout the nineteenth century, and increasingly in the twentieth, the doctrine that education is a proper charge against the public purse has meant that the state, in greater and greater degree, has made education the instrument of its own support. The nationalism which this type of education has created has in its turn created an age in which instruments of communication have prematurely thrown cultures into collision with each other before the people were ready to understand one another. This nationalism, which has rallied religion, culture, technology and science itself to its support, now includes education—and it is a necessary part of something called 'national defense'. War, technology in preparation for war, and nationalism—these are three great forces warping the healthy development of education in what we call the civilized world. The problems they raise are deeper and darker than those polite fictions discussed in most educational meetings.

Face to face with the spectre of war, with technology controlled by war, and with an intense and irrational nationalism which, as in the case of atom bomb, dreams of going to war before some other nation shall invent an even more terrible weapon—and thus, in a world in which the nations have solemnly pledged themselves to unite for peace—what have the scientists to offer for the guiding of mankind? Our problem is then deeper, more radical, and alas more nearly insoluble than a simple balancing of general gains in health, longevity, good will and control of nature against the stupendous losses of war.

Lord Bertrand Russell, the great English philosopher, in discussing the possibilities of the second half of the twentieth century, which he warns, may bring appalling disasters, says that "dislike of the Soviet system while it justifies us in resisting its forcible extension, does not justify us in going to war to change it where it exists. Our policy must not be that of crusaders, but of nations engaged in collective self-defence. And not merely self-defence, but defence of a way of life that we value. War, even if it were quickly successful, would damage this way of life; we should, when it was over, be less civilized, less humane, less capable of democracy, and less able to carry on the work of art and literature. War for civilization may sometimes be necessary, but civilization is not as good after a serious war as it was before. As guardians of certain things that we value, it is, therefore as much our duty to preserve peace if we can as it is to fight if we must."

Science is one of those human activities which have undergone a change of purpose or, at least, have come to serve different purposes, in the course of their development. Disinterested curiosity has been the great motive power of scientific research. Of the great "values" that condition our activities and make our lives worth living, viz. Goodness, Beauty and Truth, Science has been chiefly concerned with Truth. But "truth" does not seem to be a simple and unambiguous concept. We hear of "higher truths" and "deeper truths". We may ask then, 'What sort of truth is science after? In what sense is a true scientific statement true?' Some confusion no doubt arises. The criticism has indeed been made that science pays for its success by its superficiality. It has been pointed out that all the deepest problems of mankind lie outside science. If neither philosophy nor religion can present any such "body of tested knowledge", it is because they have not been content with such cheap victories. There is doubtless some truth in this criticism, and it is probably true that the problems with which science deals are intrinsically inferior in human interest to those dealt with by either philosophy or religion.

Nevertheless, the actual atmosphere of science, the manner in which it goes about its work, is quite exceptionally agreeable. It is in the scientific attitude, as much as in the scientific results, that the true value of science is to be found.

If the man of science has not aimed high according to the philosopher, he has at least aimed with a single heart, with a docility in face of the facts, with an impersonal purpose to serve which is not always found amongst our philosophers, and which is almost impossible to find elsewhere. Hence the scientists are among the greatest benefactors of the society.

Professor Elton Mayo in his book, *The Social Problems of an Industrial Civilization*, writes :—"Technical skill manifests itself as a capacity to manipulate *things in the service of human purposes. Social skill shows itself as a capacity to receive communications from others and to respond to the attitudes and ideas of others in such fashion as to promote congenial participation in a common task. In these days, education has gone over - often extravagantly--to the development of technical skills and the appropriate scientific bases for such skills. This would be excellent were it not for the fact that the universities have failed to develop an equivalent study of and instruction in social skill. We have in fact passed beyond that stage of human organization in which effective communication and collaboration were secured by established routines of relationship.

AGAIN :

We have undertaken to transform an economy of scarcity into an economy of abundance, and the technicians are showing us the way. We are committed to the development of a high human adaptability that has not characterized any known human society in the past, and it is our present failure in this respect that finds reflection in the social chaos which is destroying civilised society.

AND AGAIN :

Under the influence of economic theory, we have a system of education that trains youngmen in technical understanding and technical skill : we do nothing whatever to develop social insight or to impart social skill. Indeed we provide an education that operates to hinder the development of such skills. And the general public, business leaders, and politicians are left with the implication that mankind is an unorganized rabble upon which order must be imposed. It was this delusion that encouraged Hitler's dreams of grandeur.

FINALLY :

We have failed to train students in the study of social situation; we have thought that first-class technical training was sufficient in a modern and mechanical age. As a consequent we may be sometimes technically competent, but we combine this with utter social incompetence. This defect of education and administration has of recent years become a menace to the whole future of civilization."

Professor Northrop also emphasizes the above opinion of Professor Mayo in his book, *The Meeting of East and West*, and says that the present civilization must re educate itself or perish. The creation in the United Nations pattern of UNESCO—the United Nations Educational Scientific and Cultural Organisation—is a crowning example of world-wide interest in the inter-relations between war, technological training for war and nationalism on the one hand, and education on the other. Education is, then a world-wide problem. The catastrophes of the last half century have affected some parts of educational system in different parts of the world. Nevertheless, it is roughly true that primary education in most countries particularly in India has not been violently altered. Our sociological theories, our political economy, and our doctrines of education are derived from an unbroken tradition of the country. The whole of this tradition is wrapped by the vicious assumption that each generation will substantially live amid the conditions governing the lives of the fathers and will transmit those conditions to mould with equal force the lives

of its children. For the first time we are beginning to realize that we are living in a period of human history for which this assumption is false. To express doubt concerning the timeless validity of tradition may shock the academic mind in India but it is nevertheless true that unless a re-orientation takes place in the traditional ideas of education there will be a disaster in the second half of the twentieth century both in social and political life of the country. The troubles lie, not with the education, but with human beings who will not live in the glory and wisdom of the tradition. Therefore the tradition must be re-taught. An attempt towards this direction is now being made by the Government of India, Ministry of Education, by inviting the attention of the public to a pamphlet on Basic and Social Education which seeks to provide a short account of what has been and is proposed to be done in the immediate future.

The discovery of murderous potentialities in nuclear energy and the invention of many death-dealing machines require that education in India must somehow take account of events in a world in which the U.S.A. and Soviet Russia have become dominant powers.—The whole of Asia is violently disturbed and man's uneasiness about his traditional values has spread from a few troubled spirits at the top of the social pyramid down among the mass of mankind everywhere. Merely to reaffirm past values by a return upon dead sages will not quite do. What we need is an educational programme that will face the present with courage and interest. One difficulty with educational programmes is that they are never built for time but are always built for eternity. Each pedagogical reformer, convinced that he has found at last a changeless and enduring way of educating human nature, announces his programme as a series of timeless absolutes. Every curriculum has an air of being built upon the impregnable rock of holy scripture, and, since academic institutions are highly conservative, the new curriculum, once alive and vital, when it becomes moribund, either changes slowly or changes not at all.

It is not necessary to launch another educational reform. What is needed is a reorientation of scientific studies in colleges, so that full implication of the *Social Function of Science* can be understood in terms of

(a) study of the theory of science and of the application of scientific discoveries to technology, and

(b) A study of the personal relationships in modern society.

Regarding item (a), it may be said that professional, vocational, technical or technological training is unavoidable in a fiercely competitive democracy. The problem is not to deny its necessity but to control and guide its force. The problem is to bring our social engineering up to the maturity of our technological engineering. A course in 'General Science', a course in the history of science, a course in the postulates of the scientific method will merely increase our technological confusion unless it is joined to something else. That something else is the study of what happens to scientific discoveries when they are practically put to work in our industrial culture. Economist and sociologist, psychologist and anthropologist must join the scientist and point out that when science invents the internal combustion engine, vast economic and sociological forces are set to work. It is insufficient to praise research for its own sake. The tremendous (and sometimes tragic) results of research for its own sake, when these results take the form of widespread technological changes in modern society, are as basic to an understanding of the modern world as any part of scientific theory. The creation of instructional units of this sort will be a matter of great difficulty, but to keep scientific theory in one compartment and economic and social studies of a technological culture in another compartment is precisely the tragic error of our education and of our culture.

Regarding item (b)—a study of personal relationships in modern society—it may be said that this is not a subject whose elements can be so specific as the elements of general education previously suggested. Still the need of restoring confidence in the relations between man and man is supreme. Perhaps, in a fiercely competi-

tive society, confidence in these relations cannot be wholly restored but the present corruption of these relations can certainly be checked and the conditions improved. To repeat Professor Mayo's words : "We have passed beyond that stage of human organization in which effective communication and collaboration were secured by established routines of relationship." Professor Mayo rightly charges the present governments with "utter social incompetence." *But the beginning of social competence is the trust of man in man*; and a wider understanding of the psychology of personal relationships seems to scientists a more desperate need in our education than polite courses in literature, philosophy and the fine arts.

A combination of all the aspects mentioned above will necessarily create a demand for laying down certain principles of a Charter for Scientists. And this was exactly what the Committee on Science and its Social Relations instituted by the International Council of Scientific Unions at its meeting held at the UNESCO House, Paris, did on the 15th and 16th June 1948. The principles of a Charter for Scientists which the Committee has drawn up can be summarised in the following sentences :—

The prominent position held at present by science in society, and the rapid transformation of the world through the application of science, carry with them for scientific workers special obligations over and above the ordinary duties of citizenship. Besides this the scientific worker has special responsibilities since he or she has the possibility of obtaining information not readily available to the average citizen. It thus becomes the duty of the scientist to :

- (a) maintain a spirit of frankness, honesty, integrity and co-operation, and to work for international understanding;
- (b) consciously examine the measuring and purposes of the work that he or she is performing;
- (c) when in the service of others enquire into the purpose for which the work is being done and the moral issues that may be involved;
- (d) promote the development of science in the way most beneficial to mankind and exert his or her influence as far as possible to prevent its misuse;
- (e) assist in the education of the people and the Government in the purposes and achievements of science.

In order to fulfill these obligations it is necessary to claim certain rights for scientists, the principal ones of which are :

- (i) freedom of publications and the utmost freedom to discuss one's work with other scientists;
- (ii) economic security and the right to participate freely in all activities permitted to all citizens; and
- (iii) the possibility of obtaining information about the purposes for which his or her work is being done.

The committee on Science and its Social Relations instituted by the International Council of Scientific Unions has also raised the question of giving attention to *man* himself as the fundamental unit of society and therefore has asked everybody to consider three principal aspects of social relations of science, viz. :—

- (i) the scientist before society;
- (ii) changes introduced in human societies through the technological development of science;
- (iii) the antagonism between biological order and social order.

In the world generally the fall of the Fascist States has left a kind of vacuum in beliefs, which must be filled; and if the democratic state has not the dynamic energy to draw to itself the affirmative allegiance of the younger generation in India then the democratic state will not have a healthy growth. The case is not simple 'patriotism'. The task of education is, along with other institutions of the state,

to furnish this dynamic. But it must be an intelligent dynamic. Hence it must deal with the individuals as units of the society. Dr. Rajendra Prasad, while he was the President of the Indian Constituent Assembly, stated at Wardha that "we must concentrate on the individual, on whom depends the solution of many problems confronting the work; the individuals jointly constitute a nation. We have to reform the individual, make him really an instrument of peace so that he may influence other individuals around him. He may influence his Government. Mahatma Gandhi tried to mould the individual throughout his activities in Africa and in India; it was individuals whom he moulded and he hoped that in that way he would be able to create a society of men in the light of his teachings. We have to take decisions which will help individuals, and which will help us all individually to create that kind of society which will banish war".

Professor Bernal just before the World War II emphasized the same aspect from the stand point of a scientist. He stated—"we have in the practice of science the prototype for all human common action. The task which the scientists have undertaken—the understanding and control of nature and of *man himself*—is merely the conscious expression of the task of human society. The methods by which this task is attempted, however imperfectly they are realized, are the methods by which humanity is most likely to secure its own future. In science men have learned consciously to subordinate themselves to a common purpose without losing the individuality of their achievements. Each one knows that his work depends on that of his predecessors and colleagues, and that it can only reach its fruition through the work of his successors. In science men collaborate not because they are forced to by superior authority or because they blindly follow some chosen leader, but because they realize that only in this willing collaboration can each man find his goal. Not orders, but advice, determines action. Each man knows that only by advice, honestly and disinterestedly given, can his work succeed, because such advice expresses as near as may be the inexorable logic of the material world, viz. stubborn facts. Facts cannot be forced to our desires, and freedom comes by admitting this necessity and not by pretending to ignore it. These are things that have been learned painfully and incompletely in the pursuit of science. Only in the wider tasks of humanity will their full use be found."

The Prime Minister of India is most anxious that the students in the Universities and technological colleges in India should know how through the instrumentality of science the political and social conditions of India are rapidly changing. The application of natural sciences for social welfare, the utilization of natural resources for social welfare, the application of biological sciences for social welfare, the engineering developments for social welfare, the social problems of an industrial civilization, are merely some of the vast number of topics which require careful attention of the faculties of science, technology, commerce and education of the universities in India.

Professor J. D. Bernal in his well known book "The Social Function of Science" has made a critical examination of the function of science in society. He narrates what science does and mentions what science should do. In the preface to his book, he says :—"It used to be believed that the results of scientific investigation would lead to continue progressive improvements in conditions of life; but the war and then economic crises have shown that science can be used as easily for destructive and wasteful purposes, and voices have been raised demanding the cessation of scientific research as the only means of preserving a tolerable civilization. Scientists themselves, faced with these criticisms, have been forced to consider effectively for the first time how the work they are doing is connected with the social and economic development which are occurring around them. . . . To begin with, it is necessary to consider the social function of science not absolutely, but as something which has grown up imperceptibly with the growth of science. Science has ceased to be the occupation of curious gentlemen or of ingenious minds supported by wealthy patrons,

and has become an industry supported by large industrial monopolies and by the State. Imperceptibly this has altered the character of science from an individual to a collective basis, and has enhanced the importance of apparatus and administration. But as these developments have proceeded in an uncoordinated and haphazard manner, the result at the present day is a structure of appalling inefficiency both as to its internal organisation and as to the means of application on problems of production or of welfare. The application of science furnishes other problems. Here the tendency in the past has been almost exclusively that of directing science towards improvements in material production primarily through lowering the cost and towards the development of the instruments of war. This has led to an almost complete neglect of those applications which would be of more immediate value to human welfare, in particular to health and domestic life. The result has been an extraordinary disproportion in the development of different sciences, the biological and still more the sociological sciences having been starved at the expense of the more immediately profitable physical and chemical sciences. Any discussion of the application of science necessarily involved questions of economics, and we are driven to enquire how far the various economic systems now existing or proposed can give the opportunity for the maximum application of science for human welfare. Further economics cannot be separated from politics. The universal preparations for a more general and terrible war have affected scientists not only as citizens, but also through their work. Science itself seems in danger. The scientist has begun to realize his social responsibility but if science is to fulfil the function which its tradition demands, and to avoid the dangers which threaten it, we require an increased appreciation, both on the part of scientists and of the general public, of the intricate relations between science and contemporary life."

The part played by various mineral substances in national economy, the geographical distribution of mineral occurrences and its bearing on the question of possible mineral sanctions have brought the science of geology (including physical geography) to the forefront of national progress. The discovery and exploitation of metallic ores and oil have been greatly assisted in recent years by improvements in geophysical prospecting. The foundation of geography is obviously a complete and precise knowledge of the physical features of the Earth's surface—mountains, deserts, rivers, lakes and islands. Our present knowledge is the cumulative result of a vast number of journeys by explorers and travellers of many nationalities. To them we owe much of our knowledge of the conditions in which a great proportion of the peoples of the world are living. The advance in the subject in various directions is bringing environmental sciences like climatology, anthropology, etc., into greater prominence. The application of aerial photography is being continually developed and maps are being revised and governments of big countries are preparing or revising their national atlases. The Mount Everest Expedition and other expeditions have added to our knowledge of Himalayan topography, biological adaptation to high altitudes and meteorological conditions. The study of nuclear constitution carried on with wild plants as well gave valuable information concerning the relationship and the geographical distribution of plants. In Ecology, Zoology links up with Botany. A principle of great interest from the zoological point of view has recently been propounded that undercrowding may be as lacking in stimulation to reproduction as overcrowding, and that there is a physiological optimum density of population. Further the phenomenon of variation and fluctuation in numbers in population has developed the science of statistics in the field of biology and other related subjects.

The processes of learning, retention and forgetting continue to engage the attention of psychologists. Particular interest is being devoted to the subject of the variation of ability and learning powers at adult ages. This is and will have a great social bearing on the education of the illiterate adults numbering many millions in India. As regards mental testing in general there has been an in-

creasing tendency to carry out large surveys in different geographical areas. Industrial psychologists are rendering considerable service to the people in general by their researches in guidance in specific avocations of life.

The natural resources of a country provide its wealth. The scientist and the engineer create it, economist attempts to control its distribution. The standard of living in the present day world is directly dependent upon the intelligent and continued use and development of these resources. Science and engineering have a deeper meaning than the mere utilisation of resources or development. It is an instrument of social progress. History has shown that the great advances in literature, art and philosophy have been made by comparatively few people who were provided, through the economic and social systems in which they lived, with the opportunity of devoting their time and energies to such advancements. In the early days this meant that many slaves were required for every scholar or member of the intelligensia who was not devoting his time to the process of earning his own living. Today scientific and engineering achievements are providing an equivalent of a large number of slaves for every man, woman and child, and in so doing it gives to all people the opportunities for an intellectual development that heretofore was restricted to very few. Engineering is not only necessary but it is also the key to technical, social and economic progress. This progress cannot be attributed entirely to the presence of natural resources. Such resources have been present for years. It has taken millions of years to bring them to human usefulness. The science and technology, through the scientists and engineers, have largely contributed to the world problems, social and economic, and to reach the mass of the country. India faces today problems of vast magnitude in her development of her social and economic conditions in which science and engineering are of paramount importance.

We speak of over-production when we never had a decent general standard of living in this country; we speak of technological unemployment when it is on technology alone that we find our solutions for higher standard of the future; we speak of our investments when an adequate provision of goods and services to the mass of our fellow citizens require large and more efficient production facilities than we ever dreamed of. In India, to-day, the conditions are changing rapidly. Policies for national welfare are in need of guiding principles. Knowledge of probable scientific and technological trends is a good help; the material factors that shall determine the economic well-being of India are the development of her scientific and technological progress and economic organisation. In a country which is trying to achieve a rapid growth and which has hitherto remained under-developed, scientifically and technologically, the first requisite is its scientific and technological achievements and their social effects later. The significance of technology for social and economic life may be given by considering certain developments of the twentieth century. Only half the century out of the twentieth century has elapsed during which the world has experienced a phase of unparalleled development. A scanning of these technological developments would reveal the present material prosperity of the western countries.

What is India's main requirement today? Food. Until 1952, every year hundreds of crores of rupees were being melted away in buying this most essential commodity in the areas of hard currencies. India is an agricultural country and should be able to more than support herself. The other problems that are facing us are a good deal of unemployment and increasing our productivity of consumer goods. These require overall measures of increasing volume of goods and services produced in the country, and the volume of labour employed in the creation of national products.

Agriculture in India today is not an industry. Because of the large variety of technologies which bear on agriculture, specialists in these fields have to contribute greatly to technological change in agriculture. The present day productivity of

the average worker in agriculture is meagre. The methods of agriculture have to be studied. Mechanisation of agriculture have to be adopted to suit Indian conditions and will have to be arranged so as to depend for its general utilisation upon the economic and physical feasibility of the country and the people. Various problems here are involved where a scientist and an engineer has to give all his best in helping the expansion of farming into new lands suited to large scale methods of production, in increasing the farm labour efficiency, in giving them electricity, in providing refrigeration for farm and dairy produce, in the reclamation of arid lands, in providing better farm buildings, in irrigation, and in pumping, in plant breeding and improvement. It does not end here. The domestic farm animals represent millions of highly adaptable factors for food, fibre or power. Health and security are major objectives of the human race. Domestic animals and their products with the benefit or means of research and technology seem to offer increasing aid towards those objectives. The technology also bears a relation in regard to the farming in the study of its soil, its use and conservation, in chemical fertilisers.

Engineering in its social relation and uplift of the country, has also the task in front of it—to supply the mineral technology, to explore, investigate the supply of fuels and raw materials on which modern life has come to depend on the resources of the under-earth. The minerals have become the greatest of the raw materials of industry, the chief basis of chemical manufacture, the chief materials of construction. The scientist and the technologist have to give it the technique of exploration and technology in mining. Apart from the economic development depending on this, the technologist has also to consider this in the defence of the country and bring his technology to bear towards some strategic minerals.

Kipling's assertion is that transportation is civilisation. In India's planned development transportation is one of the most important factors for its economic and social life. There are questions of railway transportation, highway transportation, water-borne transportation, and air transportation. The commercial air transportation is ideally suited to Indian condition, in consideration of time and space and being primarily adopted to much longer distances than the average passenger journeys. The social effects of a great and highly efficient transportation system today, in India, cannot be denied.

If not the most important, probably one of the most important reasons, for the progressing and widening of the individual human being's perception of the world around him has been the tremendous growth of communications. Radio, telegraph, telephony, special communication channels are all a prelude to India's development in its relation to the social uplift. An engineer has to consider the tremendous implications which underline the balance between engineering developments and the social and economic trends in communication.

It has been said that electricity in modern life is second in importance only to food and shelter. In India, the present power development as compared to the other civilised countries is very small. India's great potentialities must be developed soon. Civilised people of today are dependent upon power—power driven machinery for industries, power driven machinery for the furniture and furnishing of the homes, for clothes, for the materials which enter into building people's shelters, for systems of transportation, for modes of communication, in fact for all the material content of the present civilisation. The very food, drawn from farm, forest and stream, depends on systems depending upon power. Manufacturing, mining, communication, transportation and other fields of production activities have been advanced by power, shortening the time necessary to achieve the results.

The influence of science of chemistry and chemical engineering on all world trends becomes far greater when considered in its relation to social welfare. The products of the chemical industry are rarely recognised by the ultimate consumer as such because they do not reach him as individual products.

In all these technological developments there is the back-bone which is research and has to be recognised.

It is not only the above developments in which is bound up India's social and economic progress but other related parts where science and engineering has to perform its part—development of public health engineering, sanitation, water supplies, etc.

The future role of science and engineering and the scientists and engineers in the social and economic building can no longer be ignored. The Indian development has to be carried out on the basis that would take advantage of the peculiarities of the people and of the country. The extent to which India's scientific and technological personnel can bear to bring their interest in encouraging and developing these means will largely determine in the next decade her development as a country of sound social and economic conditions.

In this connection it is worthwhile making a study of the increase in world population. The two tables given below will show the distribution of population in different parts of the world.

World Population in Millions (by Continents).

Continents :	1650	1750	1800	1850	1900	1933	1940	1947	1950
Europe ...	100	140	187	266	401	519	575	579	589
North America ...	1	13	57	26	81	137	143	157	165
C. & S. America ...	12	111	189	33	63	125	132	153	163
Oceania ...	2	2	2	2	6	10	11	12	13
Africa ...	100	95	90	95	120	145	158	191	198
Asia ...	330	479	602	749	937	1121	1155	1238	1272
Total	545	728	906	1171	1608	2057	2174	2330	2400

Percentage Distribution.

	1650	1750	1800	1850	1900	1933	1940	1947	1950
Europe ...	18.3	19.2	20.7	22.7	24.4	25.2	26.4	24.8	24.5
North America ...	0.2	0.1	0.7	2.3	5.1	6.7	6.6	6.7	6.9
C. & S. America ...	2.2	1.5	2.1	2.8	3.9	6.1	6.1	6.6	6.8
Oceania ...	0.4	0.3	0.2	0.2	0.4	0.5	0.5	0.5	0.5
Africa ...	18.3	13.1	9.9	8.1	7.4	7.0	7.3	8.2	8.3
Asia ...	60.6	65.8	66.4	63.9	58.3	54.5	53.1	53.2	53.0
Total	100	100	100	100	100	100	100	100	100

The chief cause of food shortage is the steady increase in world population. In 1900 the world population was 16 hundred million human beings and in 1950 it was 2,400 millions, i.e., an increase of 50 per cent in 50 years. But the food production has not increased over 30 per cent in these 50 years and, hence, the food situation is gradually deteriorating, specially in India, which has been declared to be the hungriest country of the world in 1953 by the Statistical Department of the United Nations in New York.

The rate of growth of population in many Eastern countries is much larger than in the north west of Europe. For example, India and Pakistan had 385 millions of human beings in 1941 whilst in 1951 it was 431 millions showing an increase of 1.19 per cent per year.

The present rate of increase in the population of the world is about 1% (one per cent) every year. This means that the population of the world will double itself in less than seventy years. As a matter of fact if the average longevity be increased to a figure higher than what it is at present possibly the total population will be doubled by 2000 A.D., i.e. by the end of the twentieth century. This will create a food shortage problem of gigantic magnitude.

In India the rate of increase in population is much higher than one per cent per year. In India the death rate has shown a steady decline from the 'rather high level' of 31 per 1000, during 1931-40 to a 'moderately high level' of about 25 per thousand in 1952. The increase in population has been 141 per 1000 in 1941-50, as compared with 106 per 1000 in 1921-30. Hence the problem of production of food by means of agriculture, river conservation and control requires immediate attention of agricultural scientists, economists, and irrigation engineers. Primary source of water being rainfall it is a renewable natural resource; but owing to its limited supply and faulty distribution, conservation and control of water are inherent in the problem of its utilisation.

Nature has her own methods for the conservation and control of rainfall as compensation against its erratic distribution by having the precipitation partly in the form of snow if there is any catchment area at sufficiently high altitude, and what is more important, by absorbing and storing underground a substantial portion of rainfall, thereby reducing the run-off and the intensity of floods and at the same time providing a vast subsoil reservoir which, by percolation through the soil, throughout the year, maintains the river flow when there is no rain and no surface flow to maintain it otherwise. The utility of a river to serve our various needs mainly depends on this compensating action provided by nature which again depends on the condition of the catchment, i.e. whether it has sufficient area under vegetation, particularly deep forest, which retards run-off thereby reducing the intensity of floods and their silt-content and increases the portion of the rainfall which is absorbed and stored underground to maintain the river flow by subsoil percolation during the dry weather. It is interference with this natural economy by destruction of forests and by other harmful acts in the catchment areas and in the river channel that is responsible for most of our river problems, particularly the flood problem. To meet our growing needs, we want regular supply of water. Hence very many river valley projects have been undertaken by the Government of India. The Damodar Valley Project, the Bakra Langal Project and the Koshi River Project are all examples of schemes for generating power and for production of food and other things (industries) required for the social uplift and well-being of the people of India.

Apparently, there is some conflict between the needs of the river and those of man, as with the growth of population certain amount of interference with nature's economy is unavoidable, as room has to be found for the growing population and their needs from the land including the forests, now rapidly increasing with the progress of civilisation, have to be met. This cannot be stopped but the process should be rationalised. What is required is that with the aid of our advanced scientific knowledge, by intensive study and research, attempt should be made to effect a reconciliation between the above conflicting interests. Mere negative approach may not be sufficient having regard to our growing needs of water. Positive aid to nature's economy is also necessary by rational land management, contour trenching, bunding and terraced cultivation along the hill slopes, together with efficient preservation of existing forests and afforestation where possible etc., all with the object of reducing the rate of run-off and preventing soil erosion. Though necessary in the interest of the various forms of water uses, they are of particular importance as preventive measures against floods. They do not involve much of capital outlay but mainly require organizational effort including research and legislation. They also permit land building activities in deltaic areas which is

essential in nature's economy and help in maintaining the drainage system. It should however be emphasized that isolated action in a section of the river is not sufficient but comprehensive planning for the river as a whole is necessary irrespective of political boundary.

Of the remedial measures against floods, the most common is the construction of marginal flood embankment. At best, it is only a temporary expedient as the silt factor complicates the problem. In the economy of nature the silt is intended to be carried with the flood spill so that it could raise and fertilise the land and reduce silt content in the river channel to what its velocity could transport. Embankment interferes with this economy, deteriorates the channel and raises the flood level. It causes progressive deterioration in the drainage system, in public health and productivity of the soil by cutting off beneficial flood spill. Nor can the flood embankments offer permanent solution to the flood-problem as breaches are unavoidable which cause even greater damage due to concentrated discharge than by gradual inundation.

The problem of longevity is closely connected with the protection of human beings freeing themselves from invading bacteria of various types. Hence the researches in preparation of antibiotics have given a welcome relief from anxieties of early death due to infections of various kinds. Scientific and medical journals during the last ten years have been full of reports which testify to the astonishing efficacy of penicillin, streptomycin, auriomycin and other disease curing medicines. Can man live for ever is now a question that is being asked by many people who have seen what Hormones can do. Profound changes in the organisation of the body of an adult can be brought about by small quantities of known chemical substances, but the nature of the influences which produce normal growth and cause death in the higher types of animals is still unknown. That the over productivity of one of the ductless glands can lead to the production of giants is an indication, but no more. Yet biochemistry is re-exploring the ground first covered by physiology and strengthening the control over bodily processes with which that study had provided medicine. Although most scientists would treat the matter with utmost reserve, we cannot altogether rule out the possibility that some day in the future Ponce-de Leon's Fountain of Youth may become known.

There could be no higher end in the universe than to make a perfect world, and no more perfect moral law than that which at the same moment eliminates the unfit and establishes the fit. Too frequently the moralist's attention is diverted to the negative side, to what seems the quite immoral spectacle of the massacre of the innocent, the route and murder of the unfit. But in earlier Nature there is no such word as innocent; and no ethical meaning at that stage can attach itself to the term 'unfit'. Fitness in the stormy days of the world's animal youth was necessarily fighting fitness; no higher end was present anywhere than simply to gain for life a footing in the world and perfect it up to the highest physical form. The creature which did that fulfilled its destiny, and no higher destiny was possible or conceivable. The Survival of the Fittest, of course, does not mean the Survival of the Strongest. It means the Survival of the Adapted the survival of the most fitted to the circumstances which surround it. A fish survives in water when a leaking iron-clad goes to the bottom, not because it is stronger but because it is better adapted to the element in which it lives. A bull is stronger than a mosquito, but in an autumn drought in a partially barren country the bull dies, the mosquito lives. Fitness to survive is simply fittedness, and has nothing to do with strength or courage, or intelligence or cunning as such, but only with adjustments as fit or unfit to the world around. A prize-fighter is stronger than a cripple; but in the environment of modern life the cripple is cared for by the people, is judged fit to live by a moral world, while the juglist or any other able-bodied person, handicapped by his very health, has to conduct his own struggle for existence. Physical fitness here is actually a disqualification, what was once unfitness is now

fitness to survive. As we rise in the scale, the physical fitness of the early world changes to a fitness of different quality, this law becomes the guardian of a moral order. In one era the race is to the swift, in another the meek is to inherit the earth. In a material world social survival depends on wealth, health and power; in a moral world the fittest are the weak, the pitiable, the poor. Thus there comes a time when this very law in securing survival for those who would otherwise sink and fall, is the minister of moral ends. Application of science for improving the conditions of life must therefore keep both aspects in view.

APPENDIX

LIST OF MEMBERS

HONORARY MEMBERS

- Beaufort**, L. F., D.Sc., Director, Zoological Institute, Amsterdam, Holland.
- Bhatnagar**, S. S., D.Sc., F.R.S., F.N.I., Secretary to the Government of India, Ministry of Natural Resources and Scientific Research, New Delhi.
- Hill**, A. V., F.R.S., 16, Bishop Wood Road, Highgate, London N. 6.
- Jung**, C. G., Professor of Psychology, University of Zurich, Switzerland.
- Nehru**, Jawaharlal, Prime Minister of India, 17, York Road, New Delhi
- Raman**, Sir C. V., Kt., F.R.S., Nobel Laureate, Raman Research Institute, Hebbal, Bangalore.
- Saha**, M. N., D.Sc., F.R.S., F.N.I., Director, Indian Association for the Cultivation of Science, Jadavpur, Calcutta-32.
- Simonsen**, John Lionel, D.Sc., F.R.S., 8, Wildcraft Menor, London S.W. 15.
- Visvesvaraya**, Sir M., K.C.I.E., Upland High Ground, Bangalore.

BENEFACTORS

- Armah Oil Co.**, (India) Ltd., Digboi, Assam.
- Radialy**, Pestonji F., F.R.G.S., F.R.S.A., F.B.H.I. (Lond.), M.M.E.A., A.M.A.F., M.I.S.E., Senior Scientific Officer, Engineering Intelligence Service, Delhi.
- Ita Iron & Steel Co. Ltd.**, Bombay House Bruce Street, Fort, Bombay.

MEMBERS WITH VOTING RIGHTS

(The names of Life Members are marked with *)

A

- Abinchandani**, (Dr.) C. F., Central Rice Research Institute, Cuttack-4.
- Abrar**, M. Khan, M.Sc., Ph.D. (Minn.), Dept. of Botany, Muslim University, Aligarh.
- Acharya**, C. N., M.Sc., Ph.D., D.Sc., F.R.I.C., Chemistry Division, Indian Agriculture Research Institute, Pusa Road, Karolbagh, New Delhi.
- Adhikari**, N., Asst. Manager (Chemicals), B.C.P.W., 164, Maniktola Main Road, Calcutta.
- Adatia**, R. D., M.Sc., Ph.D., Prof. of Biology, Vice-Principal of M. M. Arts College, and N. M. Institute of Science, Nav Gujrat, Andheri, Bombay.
- Aditya**, Sudhansu, M.Sc., Asst. Geologist, Geological Survey of India, 27, Chowringhee, Calcutta-13.
- Adeshra**, (Dr.), Priyakanta Nagardas, Gandi Gate Road, Baroda.
- Adyasuaran**, Lecturer in Geography, Patna University, Patna-5.
- ***Agharkar**, S. P., M.A. (Bom.), Ph.D. (Berlin), F.L.S. (Lond.), F.N.I., Director, Maharashtra Association for the Advancement of Science, Botany Department, Law College Building, Poona-4.
- Agarwal**, P. P., I.C.S., Secretary to the Govt. of Bihar, Supply & Price Control Dept., 15, Circular Road, Patna.
- Agarwal**, R. C., Associated Instrument Manufacturers (India) Ltd., B-5, Clive Buildings, P.O. Box 2136, Calcutta.
- Agarwal**, Y. K., Lecturer in Geology, Indian School of Mines, Dhanbad.
- ***Ahmad**, Khwajin Mahammed, Director of Archaeology, Hyderabad-Deccan.
- Ahmed**, Rais, Lecturer in Physics, Aligarh University, Aligarh.
- Ahmeduddin**, (Lt) S. M., Head, Geology Dept., Osmania University, Hyderabad-Deccan.
- Aiyya**, S. V. Chandrashekhar, M.A. (Cantab.), A.M.I.E.E., S.M.I.E., Prof. of Electrical Communications, College of Engineering, Poona-5.
- Alembic Chemical Works Co., Ltd.**, Baroda-3.
- Ali**, Abde, M.Sc., M.S., Department of Chemical Technology, Osmania University P.O., Hyderabad-Deccan.
- Ali**, (Dr.) Amir, Principal, College of Agriculture, Osmania University, Hyderabad-Deccan.
- Ali**, Hamzah, Geologist, Geological Survey of India, Hyderabad Circle, A. C. Guards, Hyderabad-Deccan.
- Ali**, S. Muzafer, M.A., M.Sc., Ph.D., Reader & Chairman, Dept. of Geography, Muslim University, Aligarh.
- Ambegaokar**, (Miss) K. B., Dept. of Botany, Faculty of Science, M. S. University of Baroda, Baroda.
- Ambegaonkar**, Shrinivas Bajirao, Near G.P.O., Rao Pura, Baroda.
- Ameta**, Ram Chandra, M.A., Prof. and Head of Dept. of Mathematics, Nalanda College, Biharsharif, Patna.
- ***Amin**, A. H., M.Sc., Ph.D. (Edin. & U.S.A.), Director, Alembic Chemical Works Co., Ltd., Baroda-3.
- Amin**, Indubhai, Technical Adviser, Alembic Chemical Works Ltd., Baroda.
- Amin**, Manibhai Bhailalbhai, Depl. Ing. (Germany), Managing Director, The Sanitex Chemical Industries Ltd., Industrial Area, Gorwa Road, Baroda.
- Amin**, Dahyabhai, S., 33, Alembic Colony, Baroda.
- Amin**, Shantila M., Store Controlling, 7B, Alembic Colony, Chemical Industries Ltd. P.O., Baroda.

- Amin**, Vithalbhai Chhotabhai, Research Chemist, 13, Alembic Colony, Alembic Chemical Works Co., Ltd., Baroda.
- Ammal**, (Dr.) E. K. Janaki, Director, Central Botanical Laboratory, Botanical Survey of India, Museum House, 27, Chowringhee, Calcutta-13.
- Andleigh**, H. S., B.Sc., M.B.B.S., D.F.M., D.B. (Ind.), Reader in Pathology, S. M. S. Medical College, Jaipur.
- Anand**, B. K., M.D., P.C., M.B., Professor of Physiology, Lady Hardinge Medical College, New Delhi.
- Appajee**, Y., B.A., M.B.B.S., M.Sc. (Lond.), Principal, Medical College, Mysore.
- Arasat**, N., A.I.S.M., M.I.M.E., Chief Mining Officer, Secretariat, Patna.
- Arnikar**, H. J., M.Sc., Ph.D., Asst. Prof. of Physical Chemistry, Chief Warden, Morvi Hostel, Benares Hindu University, Benares.
- Arora**, G. L., M.Sc., D.I.C., Ph.D. (Lond.), F.R.S.E., Zoology Dept., Panjab University College, Hoshiarpur.
- Arora**, (Dr.) R. B., Prof. of Pharmacology, S. M. S. Medical College, Jaipur.
- Associated Instrument Manufacturers (India) Ltd.**, B-5, Chive Buildings, Post Box No. 2136, Calcutta-1.
- Asthana**, D. B., Asst. Geologist, Dalmia Jam & Co., Ltd., Murli Bungalow, Rohtas P.O., Shahbad, Bihar.
- Asundi**, R. K., B.A. (Hons.), M.Sc. (Bom.), Ph.D. (Lond.), Professor of Physics, Benares Hindu University, Benares.
- Atreya**, B.L., M.A., D.Litt., University Prof. and Head of the Dept. of Philosophy, Benares Hindu University, Benares.
- Auluck**, F. C., D.Sc., Reader in Physics, University of Delhi, Delhi-8.
- Alur**, K. R., Assistant Professor, Bombay Veterinary College, Parel, Bombay.
- Avasare**, M.D., M.Sc., Ph.D. (Lond.), V. P. College, Vallabh Vidyanagar, Western Railway, 2, Pratap Gunj, Baroda 2.
- Ayengar**, A. R. Gopal, M.Sc., Ph.D. (Toronto), Chief Research Cytologist & Asstt. Director, Biology Division, Atomic Energy Commission, Govt. of India, Indian Cancer Research Centre, Parel, Bombay.
- Ayer**, A. Ananthanarayana, B.A., M.B.B.S., Director, Institute of Anatomy, Stanley Medical College, Madras-1.
- Ayyar**, K. V. Sundaran, M.Sc., F.R.I.C., 3, Jagadishwara Street, Madras.

B

- Badami**, Rajashekhar, C., Dept. of Chemistry, Karnatak College, Dharwar.
- Bagchi**, C. C., B.E., M.I.E., Municipal Engineer, Municipal Board, Lucknow.
- Bagchi**, K. N., Rai Bahadur, B.Sc., M.B. (Cal.), F.I.C. (Lond.), D.T.M. (Cal. & Liverpool), 5, Ballygunge Place, Calcutta.
- Bagchi**, Kanangopal, M.Sc., Dept. of Geography, Senate House, Calcutta.
- Bagchee**, Krishnadas, M.Sc., D.Sc. (Lond.), D.I.C., F.N.I., Mycologist, Forest Research Institute College, New Forest, Dehra Dun.
- Bagchee**, Sourindra Nath, Lecturer in Zoology, Surendra Nath College, 37/D, Hindustan Road, Calcutta-29.
- Bagchi**, Sasanka Sekhar, B.E.E., A.M.E.E., Hony. Secretary, National Council of Education, Bengal, 75, Bechu Chatterjee Street, Calcutta-9.
- Bagh**, D., 5, Gopikristo Pal Lane, Calcutta-6.
- Baidya**, S. P., M.Sc., Soil Mechanics Dept., Maithon, P.O. Chirkunda, Manbhum.
- Bal**, Chandra, Major, M.Sc., Prof. of Zoology, Benares Hindu University, Benares.
- Bal**, D. V., M.Sc., Ph.D. (Liverpool), F.A.Sc., Prof. of Zoology, Institute of Science, Mayo Road, Bombay.
- Bal**, S. N., Ph.C., B.S. (Pjar.), M.S., Bengal Immunity Research Institute, 39, Lower Circular Road, Calcutta.

- Balance Works**, The, D35/68, Jangambare, Benares-1.
- Baliah**, V., M.Sc., Ph.D., Prof. of Chemistry, Annamalai University, Annamalai-nagar.
- Ballardie Thompson & Mathews**, Wellesley House, Wellesley Place, Calcutta-1.
- Bandukwala**, Kalimuddin T., I.T.C., Ph.D., Manager, Bombay Soap Factory, Ripon Road Cross Lane, Madanpura, Bombay-8.
- Bandyopadhyay**, Gaganbehari, M.Sc., D.Phil., Asst. Prof. of Mathematics, Indian Institute of Technology, Kharagpur.
- Bandyopadhyay**, K. S., M.A., D.Phil., Dy. Director, Industrial Statistics Branch, State Statistical Bureau, Govt. of West Bengal, 1, Hastings Street, (2nd Floor), Calcutta.
- Bandyopadhyay**, (Mrs.) Susama, C/o. Dr. G. Bandyopadhyay, Asst. Prof. of Mathematics, Indian Institute of Technology, Kharagpur.
- Banerjee**, B. N., Dept. of Biochemistry, Indian Institute of Science, P.O. Malle-swaram, Bangalore.
- Banerjee**, Bhupati Kumar, M.Sc., D.Phil., I.C.I. Research fellow of N.I.S.I., Indian Association for the Cultivation of Science, Jadavpur, Calcutta-32.
- Banerjee**, Bhupati, M.Sc., M.B., Prof. of Physiology, Assam Medical College, Dibrugarh.
- Banerjee**, D., M.Sc., Ph.D. (Lond.), A.R.I.S., F.I.R.I., General Manager & Technical Director, National Rubber Manufactures Ltd., Leslie House, 19, Chowringhee, Calcutta-13.
- Banerjee**, Dilip Kumar, D.Sc., Prof. of Organic Chemistry, Indian Institute of Science, Bangalore-3.
- Banerjee**, G. N., B.Sc., M. Mic. Soc., F.R.M.S., 6, West View, Opp. Dadar G.I.P. Stn., Bombay-14.
- Banerjee**, H. K., D.Sc., F.R.I.C. (Lond.), F.I.C., Deputy Director, Central Drugs Laboratory, Govt. of India, 3, Kyd Street, Calcutta-16.
- Banerjee**, Haradeb, B.A., 19, Hazra Road, Calcutta-26.
- Banerjee**, Jogesh Chandra, M.B., M.R.C.P. (Lond.), M.R.C.S. (Eng.), Medical Practitioner, 3, Creek Road, Calcutta-14.
- Banerjee**, K., D.Sc., F.N.I., Head of the Dept. of Physics, Allahabad University, Allahabad.
- Banerjee**, (Mrs.) Kanak, C/o. Prof. D. K. Banerjee, College of Engineering & Technology, Jadavpur, Calcutta-32.
- Banerjee**, Prosad Kumar, M.Sc., Dept. of Statistics, Presidency College, Calcutta.
- Banerjee**, S., Dept. of Food, Motor Transport Officer, Siliguri, W. Bengal.
- Banerjee**, S. B., Scientific Instrument Co., Ltd., 11, Esplanade, Calcutta-1.
- Banerjee**, S. S., D.Sc., F.I.P.S., M.I.R.E., Professor, College of Engineering, Banaras Hindu University, Banaras.
- ***Banerjee**, Sachchidananda, M.Sc., M.B.B.S., D.Sc. (Cal.), M.A.D.A. (U.S.A.), F.N.I., Head of the Dept. & Senior Prof. of Physiology, Presidency College, Calcutta-12.
- Banerjee**, (Dr.) Samiran, P23, Improvement Trust Road, Calcutta-14.
- Banerjee**, Subhamoy, Ph.D. (Sheffield), A.M. Inst. F. (Lond.), Research Dept., Bird & Co., Ltd., Chartered Bank Building, Calcutta-1.
- Banerji**, Sudhansu Kumar, O.B.E., D.Sc., F.N.I., 3, Ramani Chatterji Road, P.O. Rash Behari Avenue, Calcutta.
- Banerjee**, T., Ph.D. (Lond.), D.Sc., F.R.I.C., Asst. Director, National Metallurgical Laboratory, P.O. Burma Mines, Jamshedpur.
- Banerjee**, A. C., I.E.S. (Retd.), Vice-Chancellor, Allahabad University, Allahabad.
- Banerji**, Ajit Kumar, M.Sc., Ph.D., Asst. Professor of Geology, Presidency College, Calcutta-12.
- Banerji**, Arya Kumar, M.Sc., Professor of Biology, Scottish Church College, 62, Beltala Road, Calcutta-25.

- Banerji, I.**, M.Sc., D.Sc., F.N.I., F.L.S., F.A.Sc., University Lecturer in Botany, 131, Harish Mukherjee Road, Kalighat, Calcutta.
- Banerji, Nabajiban**, M.B., Director, Calcutta Clinical Research Association, 10, Rowdon Street, Calcutta.
- Banerji (Dr.) S. M.**, M.Sc., M.B., 12/5, Hazra Lane, Calcutta-29.
- Barat, Chittaranjan**, M.Sc., Dr. Ing., A.R.I.C., Technical Director, Calcutta Industrial Chemicals & Minerals Co., Ltd., 4, Earle Street, P.O. Kalighat, Calcutta-26.
- Bardhan, Nihar Ranjan**, M.Sc., Prof. of Zoology, St. Paul's College, 33/1, Amherst Street, Calcutta 9.
- Bari, Syed Shamsul**, M.Sc., Prof. of Mathematics, Midnapore College, Midnapore.
- Baria, (Mrs.) D. D. H.**, M.Sc., 'Panorama', 203, Walkeshwar Road, Malabar Hill, Bombay-6.
- Barman, Jitendra Nath**, M.Sc., A.R.I.C., F.C.S., Asst. Chief Chemist, Indian Iron & Steel Co., Ltd., Hirapur Works Laboratory, Burnpur.
- Barman Ray, A.**, 23, Sarkar Lane, Calcutta-7.
- Borooah, S. K.**, 3, Golf Course Bungalow, Civil Lines, Nagpur.
- Barooah, (Mrs.) Usha**, C/o Sri S. K. Barooah, 3, Golf Course Bungalow, Civil Lines, Nagpur.
- Barve, Prof. P. M.**, M.Sc., Chemistry Dept., Wilson College, Bombay-7.
- Barave, Raghunath Vinayak**, M.Sc., Prof. of Physics, Willingdon College, Dist. Satara (Bombay).
- Basak, G. C.**, Ph.D. (Lond.), D.I.C., Dept. of Chemistry & Metallurgy, Bengal Engineering College, Botanic Garden, Howrah.
- Basak, K. C.**, B.A., Director of Economic Research, Indian Central Jute Committee, 4, Hastings Street, Calcutta.
- Basak, Manindra Nath**, M.B., D.T.M., Medical Practitioner, 15, Anukul Mukherjee Road, Calcutta.
- Basu, (Prof.) A. K.**, M.Sc., C/o. Biological Supply Concern, 5A, Kali Dutta Street, Calcutta 5.
- Basu, Ajit Kumar**, Director, Messrs. Bien Artium Natural Sciences Ltd., 6, Mangoe Lane, Calcutta-1.
- Basu, Amiya Kumar**, Prof., Dept. of Mech. Engineering, College of Engineering & Technology, Jadavpur, Calcutta-32.
- *Basu, Anathnath**, M.A. (Lond.), T.D. (Lond.), Principal, Central Institute of Education, Probyn Road, Delhi-2.
- *Basu, B. C.**, D.Sc., F.N.I., Prof. of Entomology, School of Tropical Medicine, Chittaranjan Avenue, Calcutta.
- Basu, B. N.**, Prof. of Anatomy, R. G. Kar Medical College, 44/1, Ramdhone Mitter Lane, Shambazar, Calcutta-2.
- Basu, Birendra Chandra**, M.B., Councillor, Calcutta Corporation, 134B, Russa Road, Calcutta-26.
- Basu, (Mrs.) Indira Rani**, C/o. Dr. S. K. Basu, 39, Narkeldanga Main Road, Calcutta-11.
- Basu, J. K.**, M.Sc. (Cal.), Ph.D. (Lond.), F.N.I., Soil Physicist to Govt. B.P., Central Building, Poona-1.
- Basu, J. N.**, M.I.E., M.A.E., V.D.I., Dr. Ing., Prof. of Mechanical Engineering, College of Engineering & Technology, 25, South-End Park, Calcutta-29.
- Basu, M. R.**, Dept. of Chemistry, Indian School of Mines & Applied Geology, Dhanbad.
- Basu, Minendra Nath**, M.Sc., P.R.S., D.Phil., F.R.A.I. (Lond.), Lecturer of Science, 35, Ballygunge Circular Road, Calcutta.
- Basu, N. K.**, M.Sc., F.R.I.C., Head of the Dept. of Pharmaceutics, Banaras Hindu University, Banaras.
- Basu, (Prof.) N. M.**, D.Sc., P-556, Block 'N', New Alipore, Calcutta-33.

- Basu**, Nani Gopal, M.Sc., M.B., Lecturer in Zoology, Vidyasagar College, 16, Abhoy Sarkar Lane, Calcutta-20.
- Basu**, Narendra Mohan, M.A., F.N.I., 63, Hindusthan Park, Ballygunge, Calcutta.
- Basu**, Rabindra Krishna, M.Sc., Research Scholar, Bose Research Institute, 93/1, Upper Circular Road, Calcutta-9.
- *Basu**, S., M.Sc., F.N.I., Deputy Director General of Observatories, Meteorological Office, Lodi Road, New Delhi-3.
- Basu**, S. K., M.A., Ph.D. (Lond.), Prof. of Pure Mathematics, Presidency College, Calcutta.
- Basu**, Saradindu Ranjan, M.Sc., Vice-Principal, Teachers Training College, Corporation of Calcutta, 5/B, Jugger Nath Sur Lane, Calcutta.
- Basu**, Sarojaksha, B.Sc., Engg. (Glass), C.P.E. (Glass), M.A.E., A.M.I.E., etc., Naval Architect, Superintendent, Boat Registration, the Commissioners for the Port of Calcutta, 143, Dharmatala Street, Calcutta.
- Basu**, (Sm.) Sibani, 25, South End Park, Calcutta-29.
- Basu**, Sushil Kumar, M.Sc., M.B., Ph.D. (Edin.), D.T.M., D.P.H., Prof. of Anatomy, Nilratan Sarkar Medical College, Calcutta.
- *Basu**, U. P., D.Sc., P.R.S., F.N.I., Director, Bengal Immunity Research Institute, 39, Lower Circular Road, Calcutta.
- Baweja**, K. D., Rai Bahadur, M.Sc., Prof. of Entomology, Hindu University, Banaras.
- Bedekar**, Vman Dattatray, C/o. V. Bekar & Co., 14, Murzstan Road, Fort, Bombay.
- Behari**, Ram, M.A. (Cantab.), Ph.D., Sc.D. (Dublin), F.N.I., Dept. of Mathematics, Delhi University, St. Stephen's College, Delhi.
- *Behura**, B. K., M.Sc., Ph.D. (Edin.), F.R.E.S. (Lond.), Dept. of Zoology, Ravenshaw College, Cuttack, Orissa.
- Benwari**, N. P., M.D., Prof. of Physiology, G. R. Medical College, Gwalior.
- Berger**, (Dr.) F. W., Winthrop Products Ltd., Eastern Division, 1450, Broadway, New York 18, N.Y., U.S.A.
- Bhabha**, (Dr.) H. J., D.Sc., F.R.S., Director, Tata Institute of Fundamental Research, Apollo Pier Road, Bombay-1.
- Bhaduri**, Ajit Sankar, Dept. of Applied Chemistry, University College of Science, 92, Upper Circular Road, Calcutta.
- Bhaduri**, Baidya Nath, M.B., Visiting Ophthalmic Surgeon, Carmichael Medical College Hospital, Calcutta.
- Bhaduri**, (Dr.) J. L., D.Sc., F.N.I., F.Z.S.I., Zoological Laboratory, University College of Science, 35, Ballygunge Circular Road, Calcutta.
- Bhaduri**, N. V., M.Sc., M.B., Office-in-charge, Filariasis Research Dept. & Helminthology Research Dept., School of Tropical Medicine, Calcutta.
- Bhaduri**, P. N., M.Sc., Ph.D., F.N.I., F.L.S., Cytogeneticist, Botany Division, Agricultural Research Institute, New Delhi.
- Bhagat**, M. G., M.A., B.Sc., Ceramic Engineer, 45, Tangra Road, Calcutta.
- Bhagavantam**, (Dr.) S., Vice-Chancellor, Osmania University, Hyderabad-Dn.
- Bhagwanani**, Pritam S., Demonstrator, Botany Dept., Faculty of Science, Baroda.
- Bhagwat**, K. P., General Asstt., Dept. of Experimental Psychology, University of Poona, Poona.
- Bhagwat**, W. V., D.Sc., F.A.Sc., Head of the Chemistry Dept., Holkar College, Indore.
- Bhanot**, (Mrs.) Indira, Reader in Statistics, Baroda University, Shiv-Şadan, Pratap Ganj, Baroda.
- Bhar**, J. N., D.Sc., Reader, Institute of Radio Physics & Electronics, 92, Upper Circular Road, Calcutta-9.
- Bharadwaja**, Yajnavalkya, M.Sc., Ph.D. (Lond.), F.L.S. (Lond.), F.N.I., Dean, Faculty of Science, Head of the Dept. of Botany, Hindu University, Banaras.

- Bhargava, K. S.**, D.Phil., Ph.D. (Lond.), Prof. of Botany, D.S.B., Government College, Nainital.
- Bhaskaran, T. R.**, D.Sc., S.M., A.I.I.G., Asst. Prof. of Sanitary Engineering, All India Institute of Hygiene & Public Health, 110, Chittaranjan Avenue, Calcutta.
- Bhasin, Madan Gopal**, Head of the Geology Dept., Dayanand College, Sholapur.
- Bhat, J. V.**, Asstt. Professor of Fermentation Technology Laboratory, Indian Institute of Science, Bangalore-3.
- Bhatnagar, S. S.**, Col., M.D., Ph.D., F.R.C.P. (Lond.), I.M.S. (R), Director, Caus Research Laboratory, St. Xavier's College, 14, Zainab Manzil, Church Gate Reclamation, Bombay-1.
- Bhatnagar, Satya Prakash**, Animal Nutrition & Physiology Dept., Bengal Veterinary College, Calcutta-5.
- Bhatnagar, Vijyendra Saran**, Lecturer in Chemistry, Agra University, D. A. V. College, Dehra Dun.
- Bhatia, C. M.**, M.A., Ph.D. (Edin.), Director, Bureau of Psychology, U. P., Allahabad.
- Bhatia, M. L.**, M.Sc., Ph.D., D.Sc., Head of the Dept. of Zoology, University of Delhi, Delhi.
- Bhatia, Tilak Raj**, M.Sc., Mg. Director, Bihar Scientific Corporation, Post Box No. 61, Bankipore, Patna-4.
- Bhatt, L. A.**, M.Sc., Ph.D. (Lond.), Biddle Sawyer & Co. (India) Ltd., 25, Dalal Street, Post Bag No. 1992, Fort Bombay.
- Bhatt, L. J.**, M.A., B.T., Faculty of Education & Psychology, M. S. University, Baroda.
- Bhatt, N. B.**, Sc.D., F Inst.P., S.M.I.R.E., A M.I.E.E., Mem. A.S.A., Defence Science Organisation, National Physical Laboratory, Pussa Road, New Delhi.
- Bhatt, N. M.**, M.Sc. (Bom.), Ph.D. (Edin.), F.S.S. (Lond.), Behind Raupura Tower, Baroda.
- Bhatt, Shri Nivas**, 444, Colondganj, The Bhatt Biscuit Factory, Allahabad.
- Bhattacharya, (Dr) A. K.**, Dept. of Chemistry, University of Saugor, Saugor.
- Bhattacharya, A. P.**, Statistical Office, Irrigation Research Institute, Roorke, U.P.
- Bhattacharya, Ardhendu Shekhar**, M.Sc., Sri Arabinda Asram, Pandichari.
- Bhattacharya, B. C.**, M.Sc. Tech. (Manchester), B.Sc. (Cal.), A M.C.T., F.T.I., Principal, Bengal Textile Institute, Serampore.
- Bhattacharyya, B. K.**, D.Sc., Prof. of Organic Chemistry, College of Engineering & Technology, Calcutta-32.
- *Bhattacharya, Biswa N**, M.Sc., C/o. S. N. Bhattacharya, Esqr, 10, Bhattacharya Lane, Serampore, W. Bengal.
- Bhattacharya, G.**, M.Sc., Mg. Director, M/s. Adair Dutt & Co., Ltd., 5, Dalhousie Sq. (East), Calcutta.
- Bhattacharya, Ganga Govinda**, D.Phil., Physiology Dept., University College of Science, 92, Upper Circular Road, Calcutta-9.
- Bhattacharya, Jayanta Kumar**, B.Sc., M.B., D.P.H., M.P.H., 138, Lansdowne Road, Calcutta-29.
- Bhattacharyya, Nikhil Nath**, Mg. Director, Geologists Syndicate Ltd., 137, Canning Street, Calcutta.
- Bhattacharya, Punyabrata**, M.Sc., Ph.D., Officer-in-charge, Animal Genetics Section, Indian Veterinary Research Institute, Izatnagar, U.P.
- Bhattacharyya, S. K.**, D.Sc., F.R.I.C., Officer-in-charge, Dept. of Appl. Chemistry, Indian Institute of Technology, Kharagpur.
- Bhattacharya, Sukhamoy**, B.Sc. (Hons.), A.R.I.C., F.I.C., Bengal Immunity Research Institute, 39, Lower Circular Road, Calcutta.
- Bhaumik, H. P.**, O.B.E., M.I.E., 21/1, Mandeville Gardens, Ballygunge, Calcutta.

- ***Bhave**, V. M., M.Sc., Ph.D., A.R.I.C., Professor of Chemistry, Ramnarain Rice College, Matunga, Bombay-19.
- Bhavani**, Gulal Dharamdas, M.Sc., F.L.S., F.R.M.S., F.C.S. (Lond.), National Defence Academy, Clement Town P.O., Dehra Dun.
- Bhawalkar**, (Dr.) D. R., Dean, Faculty of Science, University of Saugor, Saugor, M.P.
- Bhawalkar**, (Mrs.) V., C/o. Dr. D. R. Bhawalkar, University of Saugor, Saugor.
- Bhide**, B. V., M.Sc., A.I.Sc., S. P. College, Poona-2.
- Bhimachar**, B.Sc., D.Sc., F.N.I., Central Marine Fisheries Research Station, 47/1, Strand Road, Calcutta-7.
- Bhola**, K. L., Mining Geologist, Atomic Energy Commission, Mayo College Line Road, Ajmer.
- Bhowmik**, B. B., M.Sc., M.Sc.Engg (Lond.), 7, Sirdar Sankar Road, Kalighat, Calcutta-26.
- Bhowmik**, Prabodh Kumar, M.Sc., Lecturer in Anthropology, Bangabasi College, 46, Rani Harsamukhi Road, Calcutta-2.
- Bhusry**, P. N., Electrical Engineer, G. E. C. (India) Ltd., Magnet House, Chittaranjan Avenue, Calcutta.
- Bidvai**, Bhalchandra K., Lecturer in Geography, Vidarbha Mahavidyalaya Amravati.
- Bikaner**, Gypsum Ltd., 21, Old Court House Street, 37, Grosvenor House, Calcutta.
- Bien Artium Natural Sciences Ltd.**, 6, Mangoe Lane, Calcutta.
- Binani**, G. D., 38, Strand Road, Calcutta.
- Biswas**, Anil Bhusan, M.Sc., Ph.D., National Chemical Laboratory, Poona.
- Biswas**, Birendra Bijoy, M.Sc., Bose Institute, 93/1, Upper Circular Road Calcutta-9.
- Biswas**, Buddhadeb, M.Sc., Paleontologist, Standard Vacuum Oil Co., Ltd., 6/14, Belegkata Main Road, Calcutta-10.
- Biswas**, (Dr.) H. G., M.Sc., D.Phil., Director, Profulla Chandra Research Laboratory, Chief Chemist, Bengal Chemical & Pharmaceutical Works Ltd., 164, Maniktolla Main Road, Calcutta.
- Biswas**, K., M.A., D.Sc. (Edin.), F.R.S.E., F.N.I., F.B.S., Superintendent, Indian Botanic Garden, Howrah.
- Biswas**, Mohini Mohan, M.Sc., Research Chemist, B. C. P. W. Ltd., 164, Maniktolla Main Road, Calcutta.
- Biswas**, P. C., M.Sc., Ph.D. (Berlin), Reader in Anthropology, Delhi University, Delhi.
- Biswas**, P. C., Prof. of Physics, Jadabpur College, 27, Sasi Bhusan Dey Street, Calcutta-12.
- Biswas**, S. K., 137, Bowbazar Street, Calcutta.
- Bole**, Navin Chandra, M.Sc., Land use Planning & Reclamation Division, Soil Conservation Dept., Hazaribagh.
- Bose**, A. K., M.Sc., M.B., M.R.C.P. (Lond.), Cardiologist, Calcutta General Hospital, 63, Elliot Road, Calcutta.
- Bose**, A. N., M.Sc., Ph.D., Lecturer in Chemistry, Lucknow University, Lucknow.
- Bose**, A. N., M.B., Pharmacologist, Bengal Immunity Research Institute, 39, Lower Circular Road, Calcutta.
- Bose**, Ajoy Kumar, Sc.D. (M.I.T.), Dept. of Applied Chemistry, Indian Institute of Technology, Kharagpur.
- Bose**, Akshoy Kumar, B.E., C.E., M.I.E., Partner, M/s. Ballardii Thompson Manhas, Engineers, Architects, 7, Wellesley Place, Calcutta.
- Bose**, Amulya Kanto, A.M.A.E., Civil Engineer, A. C. C. Ltd., Kymore Cement Works, Kymore P.O., Via Jukehi, G.I.P., Madhya Pradesh.

- Bose, Aurabinda Nath**, Ph.D., Prof of Food Technology, College of Engineering & Technology, Calcutta-32.
- Bose, B. C.**, M.D., D.Sc., D.T.M., Principal, Mahatma Gandhi Memorial Medical College, Indore.
- Bose, Benoy Kumar**, M.Sc., D.I.C., A.Inst M.M., Chief Assayer, Indian Govt. Mint, Bombay-1.
- Bose, (Mrs.) Chameli**, B.Sc. (Lond.), Dy. Director, State Statistical Bureau, 1, Hastings Street, Calcutta.
- Bose, (Dr.) D. M.**, Director, Bose Institute, 93, Upper Circular Road, Calcutta.
- Bose, H. K.**, Dept. of Anthropology, Indian Museum, Calcutta-13.
- Bose, Kalyan Kumar**, A.M.I.E., Dip.Ing. (Munich), Dr Ing. (Dresden), Asst. Prof. of Communication Engineering, Indian Institute of Technology, Kharagpur.
- Bose, Kanti Bhusan**, B.Sc., B.Sc.Pharm., Ph.C. (Lond.), 'Bhasudham', 11/1/4, Russa Road, Flat D, Calcutta-26.
- Bose, (Miss) Nandita**, B.Sc., Laboratory Asstt, Physiology Dept., Bengal Veterinary College, Calcutta-37
- Bose, Niras K.**, Dept. of Applied Chemistry, University College of Science, 92, Upper Circular Road, Calcutta.
- Bose, Nirmal Kumar**, M.Sc., Lecturer in Geography, C.U., 37, Bose Para Lane, Calcutta-3.
- Bose, P. C.**, B.Sc. Engg. (Glass), M.I.E.E., F.N.I., Chief Engineer, Public Health, West Bengal Govt., 21, Mandeville Garden, Calcutta.
- Bose, P. C.**, 25, Cubbon Road, Bangalore-1.
- Bose, P. K.**, D.Sc., Bose Institute, 93/1, Upper Circular Road, Calcutta.
- Bose, Purnendu Kumar**, M.Sc., D.Phil., Head of the Dept. of Statistics, University of Calcutta, Ashutosh Building, Calcutta.
- Bose, S.**, M.Sc., Ph.D., Poultry Research Section, Indian Veterinary Research Institute, Izatnagar.
- Bose, S. K.**, B.Sc., M.Inst.F., F.G.M.S., Fuel Economy Section, Coal Commissioner's Office, 1, Council House Street, Calcutta.
- Bose, S. K.**, A.R.S.M., B.Sc., Prof of Mining & Surveying, Indian School of Mines, Dhanbad
- Bose, (Captain) S. K.**, M.B., Prof. of Forensic & State Medicine, Calcutta National Medical College, & Prof. of Military Hygiene, Bangabasi College, Calcutta.
- Bose, Sahay Ram**, Ph.D., F.N.J., Prof. of Botany, R. G. Medical College, 12/2A, Brindaban Mallick 1st Lane, Calcutta-9
- Bose, Satyendranath**, M.Sc., F.N.I., Khaira Prof of Physics, University College of Science, 92, Upper Circular Road, Calcutta.
- Bose, Souren**, Managing Director, Power Machinery (India) Ltd., 3, Mangoe Lane, Calcutta.
- Bose, Subodh Chandra**, M.A., 62, Lake Place, Calcutta-29.
- Bose, Sudhir Kumar**, M.A., M.Sc., Applied Psychology Section, University College of Science, 92, Upper Circular Road, Calcutta.
- Bose, Suresh Chandra**, A.M.A.E., Sanitary & Structural Engineer, 292, Bowbazar Street, Calcutta.
- Bose, Utsab Kumar**, M.Sc., Ph.D., Meteorologist, Civil Aviation Training Centre, Bamrauli, Allahabad.
- Bose Majumder, Nirmal Chandra**, Prof. of Mathematics, St. Xavier's College, Calcutta.
- Brahmachari, Nirmal Kumar**, M.Sc., D.Sc., 19, Loudon Street, Calcutta.
- Brahmachari, Phanindranath**, M.Sc., M.B., M.D., 19, Loudon Street, Calcutta.
- Burman, U. R.**, M.Sc., Lecturer in Applied Mathematics, University College of Science, 92, Upper Circular Road, Calcutta.

C

- Cadambe, V.**, Asst. Director & Head of the Division of Applied Mechanics & Materials, National Physical Laboratory, Hill Side Road, New Delhi-12.
- Calcutta Industrial Chemicals and Minerals Co., Ltd**, 41, Dharamtala Street, Calcutta 13.
- Capoor, S. P.**, M.Sc., Ph.D. (Lond.), Virus Pathologist, Plant Virus Research Laboratory, College of Agriculture, Poona.
- Cassad, D. P. R.**, M.Sc. Eng. (Lond.), B.Sc., M.M.G.I., M.R.S.I. (Lond.), etc., Chartered Engineer, Managing Director, C. P. Syndicate Ltd., Dolly Dale, Byramji Tower, Nagpur, M.P.
- *Casad, Jal P.**, B.E., B.Sc., A.M.I.E., M.R.S.I. (Lond.), Chartered Engineer, C/o. B. P. Byramji & Co., Ltd, Puranik's Bungalow, 241, Victoria Road, Civil Lines, Nagpur.
- Caws, A.**, Begg. Sutherland & Co., Ltd., Sutherland House, Kanpur, U.P.
- Central Waterways Irrigation & Navigation Research Station**, Poona.
- Chadha, Yog Raj**, M.Sc., Publication Division, Council of Scientific & Industrial Research, Oldhull Road, New Delhi.
- Chhabra, B. Ch.**, M.A., Ph.D., M.O.L., F.A.S., Deputy Director General of Archaeology in India, Curzon Road, New Delhi.
- *Chibber, H. L.**, M.Sc., Ph.D., D.I.C., D.Sc., University Professor of Geology & Geography, Banaras Hindu University, Banaras.
- Chaki, M. C.**, M.A., Lecturer, Calcutta University, Hotel Savoy, 27, Sashi Bhusan Dey Street, Calcutta-12.
- Chakko, K. C.**, B.A., D.Sc. (Lond.), M.I.E., Engineering College, Aligarh.
- Chacko, (Dr.) L.**, Professor of Anatomy, Christian Medical College, Vellore, North Arcot.
- *Chacko, P. I.**, M.A., F.Z.S., Asst. Director of Fisheries, Fresh Water Biological Research Station, Poonamallee High Road, Kilpauk, Madras.
- Chalam, G. V.**, M.Sc., Ph.D., Asst. Director of Agriculture, Orissa, 12, Hadu Sahu Quarters, Cuttack-4.
- Chanchani, Amritlal J.**, Colliery Proprietor & Contractor, 18, Netaji Subhas Road (2nd floor), Calcutta.
- *Chand, Mahesh**, M.A., B.Sc., Lecturer in Economics, Allahabad University, Allahabad.
- Chand, Nikhil Bhusan**, M.Sc., Ph.D., Biochemist Tocklai Experimental Station, Indian Tea Association, Cinnamara P.O. & T.O.
- Chander, Ram**, C/o. Instrument & Chemicals Ltd, Ambala Cantt.
- Chandiok, K. C.**, B.Sc., M.Sc., M.S., M.Geol.Sug., Next to Grindlays Bank, Chandni Chowk, Delhi-6.
- Chandra, R.**, M.Sc., Dept. of Physics, University of Delhi, Delhi-8.
- Chandrasekharan, K.**, M.A., M.Sc., Ph.D., F.N.I., Professor of Mathematics, Tata Institute of Fundamental Research, Apollo Pier Road, Bombay.
- Chandy, (Miss) M.**, M.A., Ph.D., Lecturer in Zoology, University of Delhi, Delhi-8.
- Chakraborty, Dharendra Mohan**, 1, Barik Lane, Calcutta-6.
- Chakrabarti, J. N.**, Lecturer in Chemistry, Indian School of Mines & Applied Geology, Dhanbad.
- Chakraborti, Mohini Mohan**, B.E.E., A.M.F.E., A.M.I.E., Asst. Electrical Engineer, C.P.W.D., 30B, Garcha 1st Lane, Calcutta-19.
- Chakraborti, Manindra Mohan**, M.Sc., Ph.D., Dept. of Applied Chemistry, 92, Upper Circular Road, Calcutta-9.
- Chakrabarty, S. K.**, D.Sc., F.N.I., Head of the Dept. of Mathematics, Bengal Engineering College, Botanic Garden, Howrah.

- Chakraborty, Saroj Kumar**, M.Sc., Asst. Manager (Apparatus), Bengal Chemical & Pharmaceutical Works Ltd., 164, Manicktolla Main Road, Calcutta.
- Chakrabarty, Sudhir**, M.Sc., Research Worker, Jute Agriculture Research Institute, Barrackpore.
- Chakravarti, Amulyaratan**, B.Sc., M.B., F.R.C.P., F.R.S., Edin., Consulting Physician & Biochemist, 1, Furriapooker Street, Calcutta.
- Chakravorty, D. K.**, Asstt. Works Manager, Ordnance Factory, Katui, M.P.
- Chakravarti, D. K.**, B.E., A.M.I.E., Chartered Engineer, 10, Covent Road, Calcutta.
- Chakravarti, Dharendra Kishore**, M.Sc., F.G.M.S., Prof. of Petrology, Dept. of Geology, Banaras Hindu University, Banaras.
- Chakravarti, Duhkhaharan**, D.Sc., Secretary, Post Graduate Dept. of Teaching in Science, University College of Science, 92, Upper Circular Road, Calcutta.
- Chakravarti, Indra Mohan**, Lecturer, Indian Statistical Institute, 203 (Barrackpore Trunk Road, Calcutta-35.
- Chakravarti, Khagendra Mohan**, Electrical Engineer, P 47, Saktigarh, Calcutta-32.
- Chakravarti, (Prof.) Khagendra Nath**, 15/D, Ekdalia Place, Calcutta-19.
- Chakravarti, M. M.**, Zoological Laboratory, University College of Science, 35, Ballygunge Circular Road, Calcutta
- Chakravarty, Makhan Lal**, M.Sc., M.B., Ph.D., Professor of Physiology, Medical College, Calcutta.
- Chakravarti, N.**, B.Sc., M.A. (Cantab.), A.M.I.I. Director, Provincial Statistical Bureau, West Bengal, Writer's Buildings, Calcutta
- Chakravarti, N. G.**, M.Sc., Prof. of Chemistry, Presidency College, 36J, Russa Road, Kalighat, Calcutta.
- Chakravarty, Nirmal Kumar**, M.Sc., Mycology Section, State Agricultural Research Institute, Govt. of West Bengal, 239, Netaji Subhas Road, Tollygunge, Calcutta 40.
- *Chakravarti, R. N.**, D.Sc., F.R.I.C., Professor of Chemistry, School of Tropical Medicine, Chittaranjan Avenue, Calcutta 12
- Chakravorty, S.**, M.Sc., A.R.I.C., Forensic Chemist, 196, Shah Nagar, New Delhi-3.
- Chakrabarti, S. C.**, M.Sc., Ph.D., Associate Prof. of Botany, B. R. College, Agra.
- Chakravarti, S. C.**, Director, The Balance Works Ltd, D/35/68 & 69, Jangambari, Banaras.
- Chakravarti, S. P.**, M.Sc., M.I.R.E., Fellow A.Sc., Principal, Government Engineering College, P.O. Gokulpore, Jubbulpore.
- Chakravarti, Shib Charan**, Director, The Balance Works Ltd., D35/68 & 69, Jangambari, Banaras.
- Chakravarty, Sushil Kumar**, Chemist, Free India Dry Accumulators Ltd., 2, Kumarpara Road, Lillowah, Howrah.
- Charan, (Dr.) Shyama**, Reader in Zoology, Victoria College, Gwalior.
- Chari, (Dr.) K. S.**, Central Laboratories for Scientific & Industrial Research, Hyderabad-Dn.
- Chaturvedi, P. L.**, Asst. Entomologist, Agricultural Gardens, Kanpur.
- Chatterjee, A.**, M.B.B.S., Hony. Secretary, Students Welfare Committee, University of Calcutta, 28, Indra Roy Road, Calcutta-25.
- *Chatterjee, Amiya Bhusan**, M.Sc., Lecturer in Geography, Presidency College, 96, Akhil Mistry Lane, Calcutta-9.
- Chatterjee, (Dr.) Asima**, D.Sc., Reader in Pure Chemistry, Calcutta University, College of Science, 92, Upper Circular Road, Calcutta.
- Chatterjee, B. K.**, M.Sc., D.Sc., Anthropologist, Dept. of Anthropology, Indian Museum, 27, Chowringhee, Calcutta-13.
- Chatterjee, Bankim Chandra**, M.Sc., Lecturer, Pure Mathematics, Calcutta University, Master Para, Konnagar P.O., Hooghly.

- Chatterjee, (Dr.)** Baradananda, Asst. Prof. of Chemistry, Dept. of Chemistry & Metallurgy, Bengal Engineering College, Howrah.
- Chatterjee, Bimal Kumar**, Prof. of Biology, Victoria College, Cooch Bihar.
- Chatterji, D.**, M.Sc., Ph.D., F.L.S., Systematic Botanist, Botany Division, Agricultural Research Institute, New Delhi-12.
- Chatterjee, G. P.**, Ph.D., Ph.D. (Physics), M.I.N., Prof. of Metallurgy, Bengal Engineering College, Howrah.
- Chatterjee, Hemendra Nath**, M.D., F.R.S.T.M. & H., M.S., B.A.M.A.A.I., 9, Ramesh Mitter Road, Bhowanipur, Calcutta 25.
- Chatterjee, Indu Bhusan**, Sir R. B. Ghosh Scholar, Deptt. of Applied Chemistry, University College of Science, 92, Upper Circular Road, Calcutta-9.
- Chatterjee, K. C.**, C/o. Boots Pure Drug Co. (India) Ltd., Sion Works, Bombay-22.
- Chatterjee, K. L.**, 34/3, Sankar Haldar Lane, Calcutta-5.
- Chatterjee, Krishnadhan**, M.D., Chemical Tutor, Dept. of Medicine, Carmichael Medical College, 6, Amrita Banerjee Road, Calcutta 26.
- ***Chatterjee, M. L.**, M.B., D.Phil. (Oxon.), Pharmacologist, C/o. Dept. of Pharmacology, School of Tropical Medicine, Chittaranjan Avenue, Calcutta.
- Chatterjee, (Dr.)** Manomohan, Head of the Dept. of Geology, Presidency College, Calcutta.
- Chatterjee, (Dr.)** Mukunda Deb, M.R.A.S., 'Maya Kanan', Subuddhipur, Baruipur P.O., 24-Parganas.
- Chatterjee, Nimal Nath**, M.Sc., Prof. in Geology, Presidency College, Calcutta University, Calcutta.
- Chatterjee, P. K.**, Indian Statistical Institute, 206, Barrackpore Trunk Road, Calcutta-35.
- Chatterjee, (Dr.)** S. C., Datan, Midnapur, West Bengal.
- Chatterjee, S. C.**, D.Sc., F.N.I., Professor of Geology, Science College, Patna.
- Chatterjee, S. D.**, Dept. of Physics, University College of Science, 92, Upper Circular Road, Calcutta-9.
- Chatterjee, S. N.**, Proprietor, M/s. Dominion Rubber Co., 52/1, Hazra Road, Calcutta-19.
- Chatterjee, S. N.**, M.B., D.T.M., Assistant Research Worker, Leprosy Research Worker, School of Tropical Medicine, Calcutta-12.
- Chatterjee, S. P.**, M.Sc., Ph.D., D.Litt., Head of the Dept. of Geography University of Calcutta, Senate House, Calcutta.
- Chatterjee, S. R.**, Scientific Instrument Co., Ltd., B7, Ajmeri Gate Extension, New Delhi.
- Chatterjee, Sati Nath**, B.Com., A.C.A., Chartered Accountant, 20, Strand Road, Calcutta-1.
- Chatterjee, Sunil**, M.Sc., F.G.M.S., Lecturer in Geology, Ashutosh College, 56 Ritchie Road, Calcutta.
- Chatterjee, Tarak Das**, Managing Director, Continental Commercial Co., Ltd., 8/1, Dalhousie Square, Calcutta.
- Chatterjee, Udayan**, Dy. Director of Industries (Research), Directorate of Industries, 7, Council House Street, Calcutta.
- ***Chatterji, A. C.**, Dr.Ing., D.Sc., Prof. & Head of the Dept. of Chemistry, Dean, Faculty of Science, The University, Lucknow.
- Chatterji, Banbihari**, M.Sc., M.B., Medical Practitioner & Lecturer in Physiology, Calcutta University, 82, Dr. Suresh Sarkar Road, Entally, Calcutta-14.
- Chatterji, N. N.**, M.B., B.S., M.Sc., Lumbini Park Mental Hospital, 121, Badiadanga Road, P.O. Tiljala, Calcutta.
- Chatterji, S. K.**, M.B., D.T.M., Ph.D., Near Duplex College, Barabazar, Chander-nagar.

- Chatterji, S. N.**, Electrical Engineer, C/o. B. I. Callenders' Cables Ltd., 9, Hare Street, Calcutta.
- ***Chatterji, Salil Kumar**, B.Sc. (Mining), Mining Engineer & Prospecting Geologist, B/86, Daroging, Allahabad.
- Chatterji, Satyabrata**, A.M.M.E., Asst. Director of Supplies, Ministry of Industry & Supply, Govt. of India, 8, Ramnidhi Chatterji Lane, Uttarpara.
- Chatterji, Usha Nath**, D.Phil., D.Sc., F.N.I., Chief Editor, Indian Council of Agriculture Research, 11, Jorebagh Road, New Delhi.
- Chattopadhyay, Haripada**, M.Sc., Dept. of Physiology, Presidency College, Calcutta-7.
- Chattopadhyay, K. P.**, M.Sc., Prof. of Anthropology, Calcutta University, 2, Palm Place, Ballygunge, Calcutta.
- Chattopadhyay, S. B.**, D.Sc., Mycologist, Govt. of West Bengal, State Agricultural Research Institute, 230, Netaji Subhas Road, Tollygunge, Calcutta-33.
- Chaudhuri, A. K.**, Lecturer in Mathematics, Indian Institute of Technology, Kharagpur.
- Chaudhuri, Abaninath**, Lecturer in Geology, Calcutta University, Presidency College, Calcutta.
- Chaudhuri, Anil**, M.Sc., M.B., D.T.M., Medical Practitioner, 8, Ananda Banerjee Lane, Calcutta-20.
- Chaudhuri, B. N.**, B.E., M.I.E., M.R.S.I., Civil Engineer—Architects, Chaudhuri & Guha, 10, Hastings Street, Calcutta-1.
- Chaudhuri, (Sm.) Bina**, B.A., Signet Press, 19/2, Elgin Road, Calcutta-20.
- Chaudhuri, Bhupendra Nath**, M.Sc., Research Worker, Dept. of Physiology, University College of Science, 92, Upper Circular Road, Calcutta.
- Chaudhuri, D. K.**, M.Sc., D.Phil., Ph.D., Dept. of Applied Chemistry, University College of Science, 92, Upper Circular Road, Calcutta-9.
- Chaudhuri, Dhisandhi**, 39, Chaudhurypara Lane, Santragachi P.O., Howrah.
- Chaudhuri, Hari Sankar**, M.Sc., D.Phil., P.E.S., Prof. of Zoology, Govt. Degree College, Nainital, U.P.
- Chaudhuri, Hiran C.**, M.A., Ph.D., P.R.S.E., 49/3, Ballygunge Place, Calcutta-19.
- Chaudhuri, J. P.**, M.B., D.P.H. (Lond.), D.T.M. (Liver), D.P.H. (Edin.), Health Officer, Calcutta Corporation, 16, Braunfeld Row, Calcutta-27.
- Chaudhuri, K. C.**, Chemist & Metallurgist, Locomotive Works, Jamalpur.
- Chaudhuri, (Dr.) K. C.**, 56/2, Creek Row, Calcutta-14.
- Chaudhuri, Kantilal**, M.Sc., Bose Research Institute, 93, Upper Circular Road, Calcutta-9.
- Chaudhuri, Manoranjan**, M.A., Prof. of Geography, Vidyasagar College, 39, Sankar Ghosh Lane, Calcutta.
- Chaudhuri, R. N.**, M.B., M.R.C.P., T.D.D., F.N.I., Director, Calcutta School of Tropical Medicine, Central Avenue, Calcutta.
- Chaudhuri, S. S.**, A.I.E.E., Chief Engineer, N. E. W. Mills, Dhariwal, Punjab.
- ***Chauhan, B. S.**, M.Sc., Ph.D., F.Z.S., F.Z.S.I., Zoological Survey of India, 34, Chittaranjan Avenue, Jabakusum House, Calcutta-12.
- Chavan, A. R.**, B.Sc., Ph.D., Prof. of Biology, Baroda College, Baroda.
- Chib, R. C.**, Council of Scientific & Industrial Research, New Delhi.
- Chief Chemist**, The Bhagat Oil Mills, 32/4, Sahitya Parishad Street, Calcutta.
- ***Chiplonkar, G. W.**, D.Sc., Head of the Dept. of Geology, University of Saugor, Saugor, C. P.
- Chiplonkar, M. W.**, M.Sc., D.Sc., 'Herakles Home', Poona-4.
- Chiplonkar, (Dr.) V. T.**, Spectroscopic Laboratories, Institute of Science, Mayo Road, Fort, Bombay.
- Chitale, (Mrs.) S.**, 'White Hall', Congress Nagar, Nagpur.
- Choudhuri, (Dr.) B. N.**, Pharmacologist, Central Drugs Laboratory, 3, Kyd Street, Calcutta-16.

- Choudhury, Gour Chandra**, 10B, Nafar Kundu Road, Calcutta-26.
- Choudhury, J. K.**, M.Sc., M.Sc.Tech., Asstt. Prof., Electric Engineering Dept., College of Engineering & Technology, Jadavpur, Calcutta-32.
- Choudhury, (Dr.) P. K.**, 75, Maharaja Tagore Road, Calcutta-31.
- Cholkar, V. B.**, M.Sc., Senior Lecturer in Mathematics, Faculty of Science, M. S. University, Baroda.
- Chona, B. L.**, Ph.D. (Lond.), D.I.C., Indian Agricultural Research Institute, New Delhi.
- Chopra, B. N.**, D.Sc., F.N.I., Deputy Fisheries Development Adviser to the Govt of India, Ministry of Agriculture, New Delhi.
- Chopra, R. L.**, Proprietor, Chopra Plaster Works, Ambala Cantt.
- Chopra, Col (Sir) R. N.**, C.I.E., M.A., M.D., F.N.I., F.R.A.S.B., Bt. Col., I.M.S. (Retd.), Director, Drug Research Laboratory, Canal Road, Jammu-Tawi.
- Chopra, (Miss) S.**, M.Sc., (Ohio), C/o. John Tinson & Co. Ltd, 54, Queensway, New-Delhi.
- Choudhry, A. P.**, M.Sc., Asst. Technology Officer, I.C.I. (India) Ltd, 18, Strand Road, Calcutta.
- Chunder, S. C.**, M.Sc., C/o The Scientific Instrument Co., Ltd, 240, Hornby Road, Fort, Bombay.
- Chowdhury, A. N.**, M.Sc., Asst. Chemist, Geological Survey of India, 27, Chowringhee Road, Calcutta-13.
- Chowdhury, Amal Chandra**, M.Sc., D.Phil., Lecturer in Mathematics, Calcutta University, 7A, Bagdipara Lane, P.O. Konnagar, Hooghly.
- Chowdhury, Dipti Kalyan**, Dept. of Applied Chemistry, University College of Science, 92, Upper Circular Road, Calcutta.
- Chowdhury, H. D.**, B.Sc., A.M.I.Mech.E., Director of Engineering, Home (Transport) Dept., Govt. of W. Bengal, P-11, Mission Row Extn., Calcutta.
- Chowdhury, J. K.**, M.Sc., Ph.D., F.N.I., Head of the Dept. of Chemistry, Bose Institute, 93, Upper Circular Road, Calcutta.
- Chowdhury, K. Ahmad**, M.B.E., D.Sc. (Edin.), M.Sc., F.N.I., Wood Technologist, Forest Research Institute, New Forest, Dehra Dun, U.P.
- Corbella, Jose M.**, S.J., Director of the Chemistry Dept., St. Xavier's College, Bombay-1.
- Craftsman Electronic Corporation Ltd.**, Manufacturers of Industrial & Research Scientific Instruments, Sethna Hall, Nesbit Road, Mazgaon, Bombay-10.
- *Cursetjee, (Miss) J. M.**, 'Behistan', 169, Colaba Road, Bombay-5.

D

- Dakshy, S. N.**, B.Sc. (Cal.), B.E. (Elec.), Office of the Asst. Engineer, Western Electrical Sub-Division, No. 1, W. & B. Dept., Kidderpore Bridge Approach, P.O. Hastings, Calcutta-22.
- Damle, (Principal), V. P.**, Ph.D., Professor of Biology, Pratap College, Amalner.
- Dangayach, K. B.**, Asstt. Director of Industries & Commerce (Statics), Rajasthan, Jaipur.
- Dasannacharya, (Prof.) B.**, Dept. of Physics, Hindu University, Banaras.
- Das, Amalananda**, M.B., M.R.C.S., M.R.C.P., Prof. of Medicine, Suit No. 19, Palace Court, 1, Kyd Street, Calcutta-16.
- Das, Asoke**, M.Sc., Bose Institute, 93, Upper Circular Road, Calcutta-9.
- Das, Bhupendra Chandra**, M.Sc., Prof. of Mathematics, Presidency College, 48/7, Manoharpukur Road, Calcutta-29.
- Das, Ganadeb**, 15, Rama Prasad Raj Lane, Calcutta-6.

- Das, J.**, Lecturer, Communication Engineering Dept., Indian Institute of Technology, Kharagpur.
- Das, K. N.**, M.Sc., Asst. Research Officer, Central Inland Fisheries Research Station, Barrackpore.
- Das, Kamal Krishna**, Ex-Hony. Magistrate, Ex-Councillor, Corporation of Calcutta, 4A, Raja Raj Krishna Street, Calcutta-6.
- Das, Kanai Lal**, M.Sc., M.M.G.I., F.G.M.S., 25, Abinash Banerjee Lane, Santragachi P.O., Howrah.
- Das, (Prof.) M. S.**, Research Officer, Bacteriology, Indian Veterinary Research Institute, Mukteswar-Kumaun, U.P.
- Das, (Dr.) Nagendra Nath**, M.Sc., M.B., Honorary Physiologist cum Electro Encephalographist, Presidency General Hospital, & Brain Research Expert, UNESCO, Lecturer in Physiology, University College of Science, 92, Upper Circular Road, Calcutta.
- Das, P. K.**, M.Sc., D.I.C., Meteorologist, Meteorological Office, Civil Aerodrome, Gauhati.
- Das, R. P. (Dr.)**, Dey's Medical Stores Ltd, 6/2B, Lindsay Street, Calcutta-10.
- Das, S. P.**, B.E., A.M.I.E., Civil Engineer, C/o. Braithwati Burn & Jessop Construction Co. Ltd, Post Box No. 264, Calcutta-1.
- Das, S. R.**, M.Sc., Asst. Radiologist, Dept. of Anthropology, Govt. of India, Indian Museum, Calcutta-13.
- Das, Sisir Chandra**, M.Sc., Prof. of Mathematics, Chandernagore College, Chandernagore.
- Das, Sudhir Ranjan**, M.A., D.Phil., Lecturer, Dept. of Anthropology, University of Delhi, Delhi.
- Das, Sudhindra Nath**, M.Sc., Asst. Professor in Chemistry, Science College, Patna-5.
- Das, Tarak Chandra**, M.A., Lecturer in Anthropology, University College of Science, 35, Ballygunge Circular Road, Calcutta.
- Dass, C. M. S.**, Lecturer in Zoology, Central College, Bangalore.
- Das Gupta, A. B.**, Geologist, Assam Oil Co., Ltd., Digboi, Upper Assam.
- Das Gupta, C. R.**, M.B., D.T.M., Officer-in-charge, Haematology Dept., School of Tropical Medicine, Calcutta.
- Das Gupta, (Sm.) Chinmoyee**, Mycology Section, State Agriculture Research Institute, 230, Netaji Subhas Road, Tollygunge, Calcutta-33.
- Das Gupta, Gopal Chandra**, Chief Chemist, National Tobacco Co. of India Ltd., Agarpara, Kamarpati, 24-Parganas.
- Das Gupta, H. N.**, D.Sc., Prof. of Chemistry, Fuel & Metallurgy, Indian School of Mines & App. Geology, Dhanbad.
- Das Gupta, Jitendra Nath**, B.A., B.E., M.I.E., M.A.E., M.R. San. I., M.I.R.C., M.R.A.S.B., Consulting Engineer, (Retd. Chief Engineer, Town Planning, West Bengal), 27, Lansdowne Terrace, Calcutta 26.
- Das Gupta, N. R.**, Prof. of Engineering, Indian School of Mines and Applied Geology, Dhanbad.
- *Das Gupta, Nitroj**, M.Sc., Ph.D., Prof. in Biophysics, Calcutta University, Institute of Nuclear Physics, 92, Upper Circular Road, Calcutta.
- Das-Gupta, P. N.**, M.Sc., Ph.D., Retd., Prof. of Mathematics, P.O. Kadamkuan, Patna-3.
- Das-Gupta, S. M.**, M.Sc., Ph.D., Senior Lecturer in Chemical Technology, 8, Hasan Building, Nicholson Road, Kashmir Gate, Delhi.
- Das-Gupta, Satindra**, M.Sc., D.Phil., Research Chemist, B.C.P.W., 164, Maniktolla Main Road, Calcutta.
- Das Gupta, Satyendra Sankar**, B.Sc., B.T., Asst. Teacher, Umakanta Academy, Agartola, Tripura.

- *Das Gupta**, Sivaprasad, Lecturer in Geography, Presidency College, 126, Sovabazar Street, Top Floor, Calcutta-5
- Dastur**, (Dr.) H. P., Medical Officer, Dept. of Industrial Health, Tata Industries Ltd., Bombay House, Fort, Bombay.
- Dastur**, (Dr.) Noshir, Dairy Chemist, Indian Dairy Research Institute, Hosur Road, Bangalore 1.
- Dastur**, R. H., M.Sc., F.N.I., 52, Mall Mhow, M.B.
- Datar**, D. S., M.Sc., Ph.D., A.I.I.Sc., Scientific Officer, Central Laboratories for Scientific & Industrial Research, Hyderabad-Dn.
- Datta**, J. B.A., C.E., M.I.E., Dt. Engineer, The Concrete Association of India, Exhibition Road, Post Box No. 88, Patna
- Datt**, Narendra Lal, M.Sc., Scientific Officer, Organic Chemistry Divn., National Chemical Laboratory, Poona.
- Datta**, Aniya, M.Sc., 11/B Marcus Lane Calcutta-7
- *Datta**, J. N., M.B., 15, Rammoy Road, Calcutta-25.
- Datta**, M. N., M.Sc., Asst. Superintendent, Zoological Survey of India, 34, Chittaranjan Avenue, Calcutta-12.
- Datta**, Manoranjan, M.Sc., Tech., Ph.D., A.M.I.E.E., Divisional Engineer, Electricity Development, 4, Hastings Street, Calcutta.
- Datta**, S. K., M.Sc., A Inst P., General Manager, The Scientific Instrument Co. Ltd., 6, Tej Bahadur Sapru Road, Allahabad-1.
- Datta**, Silen, B.Sc., M.B., 9A, Manomohan Bose Street, Calcutta-6
- Datta**, Tara Pada, B.E., M.I.E., F.A.P.I.C., F.A.M.U.S.T., M.A., Trade Mark, Patent & Design Attorneys & Engineers, Retd. Dy. Controller of Patents & Designs 1/1, Rupchand Mukherjee Lane, Calcutta 25.
- Datta-Majumder**, N., B.L., M.A., Ph.D., F.R.A.S., 101A, Ballygunge Place, Calcutta.
- Dave**, B. G., Behind Jubilee Garden, Katerpole, Near Liberty Garage, Baroda.
- Dave**, Bhanuprasad Hariprasad, B.Sc., Faculty of Technology, Bajawada Suctusca, Baroda.
- Dave**, J. S., Lecturer in Chemistry, Faculty of Science, S. J. Science Institute, M. S. University, Baroda.
- Dave**, M. B., F.I.I.A., Architect, Head of Architecture Dept., 24, Residency, Baroda-2.
- Dave**, N. L., Moti Bhawan, Mamr's Pole, Raopura, Baroda.
- Dayal**, Jagadeshwari, D.Sc., Lecturer in Zoology, Lucknow University, Lucknow.
- De**, Aniruddha, M.Sc., Research Scholar, Geology Dept., Calcutta University, Presidency College, College Street, Calcutta.
- De**, Bimaleswar, M.A., Ph.D., Asstt. Prof. of Psychology, Patna University, Patna-5.
- De**, H. P., M.Sc., F.R.S., Prof. of Physics, Vidyasagar College, Calcutta.
- De**, K. L., M.Sc., B.Sc. Engg., A.C.G.I., Offg. Executive Engineer (Drainage), Calcutta Corporation, 5, Suren Banerjee Road, Calcutta.
- De**, K. N., B.Sc., M.B., F.C.C.P., Jr. Visiting Physician, Chest Dept., Medical College Hospital, Calcutta, 1/1, Radhanath Chowdhury Road, Calcutta-15.
- De**, Kamini Kumar, Asstt. Prof., Dept. of Mathematics, Presidency College, Calcutta.
- De**, Nagendranath, M.B., D.T.M., M.R.C.P., D.P.H., Lecturer in Psychology, Calcutta University, Visiting Physician in Charge of the Dept. of Neurology & Psychiatry, Calcutta Medical College Hospitals, 151/1, Cornwallis Street, Calcutta-6.
- *De**, S. S., Food Agriculture Organisation of the United Nations, Maliwan Mansions, Phra Atit Road, Bangkok, Thailand.
- De**, (Mrs.) Suchitra, Gallery Asstt., Dept. of Anthropology, Indian Museum, 27, Chowringhee, Calcutta-13.

- Deb, (Dr.) B. C.**, Chief Research Officer, Central Water Power Irrigation & Navigation Research Station, Poona.
- Deb, S.**, Docteur es Sciences, Prof. of Geology, College of Engineering & Technology, Jadavpur, 8/1, Dover Lane, Rashbehari Avenue, P.O., Calcutta.
- Deb, (Mrs.) Santa, M.A., B.T., T.D.**, Dept. of Psychology, University College of Science, 8/1, Dover Lane, Rashbehari Avenue, P.O., Calcutta.
- Deekshitulu, M. N.**, B.Sc., Geological Survey of India, 27, Chowringhee, Calcutta.
- Deolalkar, Sharatchandra Tryambak, Ph.D.**, Institute of Science, Mayo Road, Fort, Bombay.
- Deolalkar, T. K.**, M.A., B.Sc., Retired Prof., C-1, Karnatak Building, Bombay-16.
- Deputy Director General of Observatories, Climatology & Geophysics**, Poona-5.
- Deoras, P. J.**, M.Sc., I.L.B., Ph.D., Asstt. Director 1/a Dept., Haffkine Institute, Parcl, Bombay-12.
- Desai, Bhagirath N.**, Demonstrator in Zoology, Dept. of Geology, Faculty of Science, M. S. University, Baroda.
- Desai, (Dr.) D. D.**, Spectroscopic Laboratories, Institute of Science, Mayo Road, Fort, Bombay.
- Desai, Kantilal Bhagvanji, B.Sc.**, Research Scholar, Faculty of Science, M. S. University, Baroda.
- Desai, (Dr.) M. H.**, 3A, Court Road, Civil Lines, Delhi-8.
- Desai, Narendra Jayantilal, B.Sc.**, Junior Research Scholar, Govt. of India, Faculty of Science, M. S. University, Baroda.
- Desai, (Dr.) R. D.**, M.Sc., D.Sc., F.N.I., F.I.I.Sc., F.A.Sc., D.I.C., Principal, L. D. Arts College & M. G. Science Institute, Navarangapura, Ahmedabad-9.
- Desai, R. J.**, Pandurang Niwas, Burnpura, Baroda-1.
- Desai, Ramanbhai Lallubhai, B.Sc., B.Sc.Tech., Ph.D. (Leeds)**, Reader in Textile Chemistry, Faculty of Technology, Kala Bhavan, University of Baroda, Baroda.
- *Desai, Shrishkant Varajraj, D.Sc. (Lond.), Ph.D., D.I.C., F.A.Sc.**, 17, Manchulhai Road, Malad, Bombay.
- Desarkar, Birendra Kumar, B.Sc.**, Research Asstt., Jute Agriculture Research Institute, Barrackpore
- Deshmukh, D.Sc.**, Geologist, Geological Survey of India, Hyderabad Circle, A. C. Guards, Hyderabad-Dn.
- Deshmukh, Yeshwantrao Shankarao**, Demonstrator in Botany, M. S. University of Baroda, Baroda.
- Deshpande, B. G.**, Geological Survey of India, Botawala Chambers, Sir Phiroze shah Mehta Road, Bombay-1.
- Deshpande, (Prof.) J. V.**, Siddharth College, Fort, Bombay.
- Deshpande, K. B.**, Botany Dept., Osmania University, Hyderabad-Dn.
- Deshpande, M. N.**, Superintendent, Dept. of Archaeology, Western Circle, Baroda
- Devasthale, V. V.**, B.Sc., C/o. V. P. Panekar, General Merchants, Market Road, Dharwar.
- Devi, Lakshmi, B.A.**, C/o Dr. B. N. Prasad, Lakshmi Niwas, George Town, Allahabad.
- Devi, (Miss) P.**, M.Sc., Ph.D., Asst. Dairy Technologist, Indian Dairy Research Institute, Bangalore-1
- Devi, (Sm.) Shakuntala**, C/o. Dr. Brij Mohan, Banaras Hindu University, Banaras.
- Dey, A. K.**, Ph.D., D.I.C., Superintending Geologist, Geological Survey of India, Southern Circle, 4/5, D'Sylva Road, Madras-4.
- Dey, A. K.**, M.Sc., D.Phil., F.N.A.Sc., Lecturer in Chemistry, University of Allahabad, Allahabad-2.
- Dey, B. B.**, M.Sc., D.Sc., F.I.C., F.N.I., I.E.S.S., Director, Central Electro-Chemical Research Institute, Alagappa College P.O., Karaikudi.
- Dey, B. N.**, D.Sc., 11, Lower Rawdon Street, Calcutta.

- Dey, D. C.**, Chief Whip, Govt. of West Bengal, Home (Constitution & Election), Dept., Chief Whip's Section, Writers Building, Calcutta.
- Dey & Paul Co.**, Building Contractor, 243, Upper Circular Road, Calcutta.
- Dhingra, D. R.**, M.Sc., Ph.D., A.R.I.C., Industrial Chemist to U. P. Govt., Principal, Harcourt Butler Technological Institute, Kanpur.
- Dhingra, Som Nath**, C/o. M/s. Jesaram Jaikrishan, 90/103, Ifikharabad, Kanpur.
- Dhar, Dr. S. N.**, Dr Ing., B.Sc., M.I.S.E., Provincial Industrial Research Laboratory, Patna University P.O., Patna.
- Dhar, J.**, M.Sc., D.Phil., A.Inst.F., F.G.M.S., Reader in Science, National Defence Academy, Prem Nagar P.O., Dehra Dun.
- Dhar, M. L.**, M.Sc., Ph.D., F.R.I.C., Asst. Director (Chemistry), Central Drug Research Institute, Chatter Manzil Palace, Lucknow.
- Dhanda, (Dr.) M. R.**, Head of the Divn. of Pathology & Bacteriology, Indian Veterinary Research Institute, Mukteswar-Kumaun, U.P.
- Dharmatti, S. S.**, Tata Institute of Fundamental Research, Apollo Pier Road, Bombay-1.
- Dharmaji Rao, (Miss) Savant Sharadchandrika**, Senior Research Scholar, Govt. of India, Botany Dept., Faculty of Science, M.S. University, Baroda.
- Dholakia, Jhavalal K.**, M.I.M.E., Mining Engineer, Nagarchakala, Bhuj P.O., (Cutch).
- Dingo, P. M.**, Senior Lecturer in Electrical Engg., University Flats, Baroda
- Director of Agriculture**, Assam, Shillong.
- Director of Agriculture (Research)**, Bhopal.
- Director, Central Building Research Institute**, Roorkee, U.P.
- Director of Economics Intelligence & Statistics**, Uttar Pradesh, 9, Sarojini Naidu Marg, Lucknow.
- Director General of Observatories**, Lodi Road, New Delhi.
- Director, Railway Testing & Research Centre**, Ministry of Railway, Alambagh, Lucknow
- Director, Regional Meteorological Centre**, Calcutta.
- Dixit, K. R.**, Prof. of Physics, Institute of Science, Mayo Road, Bombay 1
- Dixit, S. C.**, Major, M.A., M.Sc., Peplapola, Nadiad (Dt. Kaira).
- Dixit, V. M.**, M.Sc., Primrose Villa, Opp. Head Post Office, Dharwar.
- Dixitulu, J. V. H.**, M.Sc., Head of Fisheries Technology & Navigation Section, Andhra Polytechnic, Kakinada.
- Doja, M. Q.**, B.Sc., B.A., A.R.P.S., Principal, Science College, Patna
- Dole, Krishnaji Khando**, M.Sc., Ph.D., Prof. of Chemistry, Fergusson College, Krishna Kunja, 33/37, Yerandawane, Poona 4.
- Dongre, R. V.**, Dongre Buildings, 384, Lamington Road, Bombay-4.
- Dosajh, Nandlal**, M.A., B.T., P.E.S., Head of the Dept. of Psychology, Govt. Training College for Teachers, Jullundur, Punjab.
- Doss, K. S.**, D.Sc., F.R.I.C., F.Inst.P., F.A.Sc., Head of the Chemistry & Chemical Engineering, Indian Institute of Sugar Technology, Kanpur.
- Dravid, (Prof.) R. K.**, Professor's Quarters, Karnatak College, Dharwar.
- Dube, (Prof.) G. P.**, Principal, Ranchi College, Ranchi.
- Dube, (Sm) Leela**, Lecturer in Social Anthropology, Osmania University, Hyderabad-Dn
- Dubey, R.**, Head of the Dept. of Geology, Allahabad University, Allahabad.
- Dube, (Dr.) S. C.**, Lecturer in Anthropology, Dept. of Sociology, College of Arts & Commerce, Osmania University, Hyderabad-Dn.
- Dutt, A. B.**, Geological Survey of India, 27, Chowringhee, Calcutta-13.
- Datta, Amarendra Nath**, B.Ag., Agronomical Asstt., Jute Agriculture Research Institute, Lalkuthi, Barrackpore.
- Dutt, (Sm.) Anima**, B.Sc., 32, Bhupen Bose Avenue, Calcutta-4.
- Datta, Asoka Gopal**, 14, Ananda Chatterjee Lane, Calcutta-3.

- Dutt**, Kaviraj Atul Behari, B.Sc., Kaviratna, Superintendent, Bangiya Unmad Asram, 29A, Vivekananda Road, Calcutta-7.
- Dutt**, (Mrs) Mridula, M.A., Bose Institute, 93, Upper Circular Road, Calcutta.
- Dutt**, N. L., M.Sc., F.A.Sc., Director, Sugarcane Breeding Institute, P.O. Lawbey Road, Coimbatore.
- Dutt**, N. V. B. S., Asstt. Geologist, Geological Survey of India, Central Circle, Hyderabad-Dn.
- Dutt**, S. R., A.M.A.E., Sub-Divisional Officer, M.E.S., Allahabad.
- Dutt**, Sudhir Chandra, Major, M.B., I.M.S. (Retd.), 8, Little Russell Street, Calcutta-16.
- Dutta**, Arun Kumar, D.Sc., F.N.I. Mayurbhanj Professor of Physics, Utkal University, Cuttack.
- Dutta**, (Miss) (Prof.), Bina, M.Sc., Lecturer in Botany, State Agricultural College, 58/3, Raja Dinendra Street, Flat No. 4, Calcutta-6.
- Dutta**, Byomkesh, A.M.I.R.E., 5, Bhur Lane, Calcutta-6.
- Dutta**, (Mrs.) Chhabi, M.Sc., Mycro-Analyst, Dept. of Chemistry, University College of Science, 92, Upper Circular Road, Calcutta-9.
- Datta**, Dharendra Chandra, Asst. Chief Engineer & Under Secretary, P. W. D., Assam, 'Mahesh' Laiture Khrak, Shillong.
- Dutt**, M. K., M.Sc., D.Phil., Lecturer in Zoology, University of Delhi, Delhi-8.
- Dutta**, (Miss) Madhuri, M.Sc., Lecturer in Botany, Lady Brabourne College, P 1/2, Suhrawardy Avenue, Calcutta-17.
- Dutta**, N. K., M.B.B.S., D.Phil. (Oxon.), M.B.P.S (Oxon.), Asst. Director, Haffkine Institute, Parel, Bombay-12.
- Dutta**, Phanindra Chandra, D.Sc., Prof. of Organic Chemistry, Indian Association for the Cultivation of Science, Jadavpur Calcutta-32.
- Dutt**, S., D.Sc., M.R.C.V.S., D.V.M., F.N.I., Director, Veterinary Services and Animal Husbandry, Govt. of West Bengal, 1, Hastings Street, Calcutta-1.
- Dutta**, S. K., M.Sc., Metallurgical Laboratory, Inspectorate of Metal & Steel, Ishapore, W. Bengal.
- Dutta**, Sakti Kumar, Electric Foreman, N. E. Railway, Power House, Katihar.
- Dutta**, Satyendra Prasad, Lecturer in Physics, Vidyasagar College, and Atomic Research Worker, Bose Research Institute, Calcutta-9.
- Dutta**, Sujit Kumar, M.Sc., Ph.D., Bengal Immunity Research Institute, 39, Lower Circular Road, Calcutta 16.
- Dutta**, Tushar Ranjan, M.Sc., Lecturer in Botany, M. B. B. College, Agartala.
- Dutta Choudhury**, Rebati Kanta, B.Sc., M.B., Pathologist, Chittaranjan Cancer Hospital, Calcutta-26.
- Dwaraka**, D. V., M.A., Lecturer in Statistics, Osmania University, Hyderabad-Dn.

E

- East India Distilleries & Sugar Factories Ltd., The**, Nellikuppam, S. A. Dt
- Ebrahim**, (Dr.) Esmail, B.Sc., M.B., Councillor, Calcutta Corporation, 68, Canning Street, Calcutta-1.
- Ekambaram**, S. K., B.A., B.Sc., M.A., Prof. & Head of the Dept. of Mathematical Economics & Statistics, University of Mysore, Mysore.
- Engineer**, M. D., M.B., Asst. Medical Officer, Tata Industries Ltd., Dept. of Industrial Health, Bombay House, Bruce Street, Fort, Bombay-1.
- Esh**, G. C., M.Sc., Ph.D. (Ohio), F. Sigma XI (U.S.A.), Bengal Immunity Research Institute, 39, Lower Circular Road, Calcutta-16.
- *Evans**, Percy, B.A., F.G.S., F.N.I., Geologist, The Burmah Oil Co., Ltd., Britannic House, Finsbury Circus, London, E.C. 2, England.

F

Farooq, M. Omar, Department of Chemistry, Muslim University, Aligarh.

G

Gadgil, J. S., M.Sc., Asstt. Research Officer, 3rd Floor, Tata Memorial Hospital, Parel, Bombay-12

Gaekwad, Laxmanrao Krishnaji, Lecturer, Dept. of Botany, Faculty of Science, M. S. University, Baroda-1

Gafoor, K. A., Director, Social Services Dept., Central Secretariat Buildings, 14, Safabad P.O., Hyderabad-Dn.

Ganju, P. N., Ph.D. (Durbah), Ph.D. (Lucknow), M.Sc., A.I.Min.E., F.G.S., Chairman, Dept. of Geology, Muslim University, Aligarh.

Gananathan, (Prof.) V. S., Head of the Dept. of Geography, University of Poona, Poona.

Ganapati, (Dr.) P. N., Head of the Zoology Dept., Andhra University, Waltair.

Gangal, D. D., M.Sc., 624, Shadashiv, Poona-2

Ganguly, D., M.Sc., Deptt. of Psychology, University College of Science, 92, Upper Circular Road, Calcutta-9

Ganguly, Dharendra Nath, M.Sc., D.Phil., Lecturer, Dept. of Zoology, University College of Science, 35, Ballygunge Circular Road, Calcutta

Ganguli, Dharendra Nath, L.C.E., A.M.I.B.E., A.M.A.E., Engineer, Talbote Co., Tower House 36A, Chandra Mondal Lane, Calcutta-26.

Ganguli, H. N., C/o Bikaner Gypsum Ltd., 37, Grosvenor House, 21, Old Court House Street, Calcutta

Ganguly, J., B.E., M.I.E. (India), M.I.S., Chartered Engineer (India), Consulting Engineer, Architect, Survey & Valuer, 6, Hastings Street, Calcutta.

Ganguly, Mohit Kumar, Asst. Research Officer, Central Water Power Irrigation & Navigation Research Station, Poona.

Ganguli, N., Bose Research Institute, 93/1, Upper Circular Road, Calcutta-9.

Ganguli, Nripendra Chandra, M.Sc., Research Scholar, Dept. of Applied Chemistry, University College of Science, 92, Upper Circular Road, Calcutta.

***Ganguli, Nirmal**, M.B., D.T.M., D.P.H., Asst. Director of Health Services (Malaria), Govt. of West Bengal, Calcutta 1.

Ganguli, (Mrs.) Reba, 18/28, Dover Lane, Calcutta.

Ganguly, S. K., M.Sc., Bengal Immunity Research Institute, 39, Lower Circular Road, Calcutta-16.

Ganguly, Subrata, M.Sc., Dept. of Applied Chemistry, University College of Science, 92, Upper Circular Road, Calcutta-9.

Garg, Bhanwar Lal, C/o Prof. Mithon Lal Garg, Behind Kumhar Kothi Kutchury Road, Ajmer.

Garg, Shiva Chandra, B.Sc., LL.B., M.I.S.I., Statistician, Land Records Department, Govt. of Rajasthan, Jaipur.

Gayen, Anil Kumar, M.A., Ph.D. (Cantab.), Asstt. Prof. of Statistics, Indian Institute of Technology, Kharagpur.

General Manager, M. P. Sugar Mills Co., Ltd., P.O. Majhulia, Champaran Dt.

General Manufacturing Company, The Manufacturers of Balances & Scientific Instruments, Conarpura, Benares.

Geological Survey of India, The Director, 27, Chowringhee, Calcutta-13.

Geogae, J. C., Ph.D., F.Z.S., Head of the Dept. of Zoology, University of Baroda, Baroda.

George, P. C., Asstt. Research Officer, Central Marine Fisheries, Kozhikode 5, Malabar.

- *Ghadiyal**, Pestonji F., B.Sc., F.R.C.S., F.R.S.A., F.B.H.I., M.M.E.A., A.M.A.E., M.I.S.E., Technical Director, M/s. Hindustan Clocks Ltd, Prospect Chambers, 317, Hornby Road, Fort, Bombay.
- Ghandy**, (Sir) Jehangir, Representative, Tata Iron & Steel Co., Ltd. (Benefactor), Resident Director-in-charge, Tata Iron & Steel Co. Ltd., 23B, Netaji Subhas Road, Calcutta.
- Gharpure**, D. M., Gharpure & Co, P/36, Royal Exchange Place Extension, Calcutta-1
- Ghate**, (Prof.) R. V, Professor of Chemistry, S. P. College, Poona-2.
- Ghatak**, Narendranath, D.Sc., Chemical Examiner to Govts. U. P. & C. P., Agra.
- Ghosh**, A. K., M.Sc., Registrar, Bose Institute, 93, Upper Circular Road, Calcutta
- Ghosh**, A. M., Bose Research Institute, 93/1, Upper Circular Road, Calcutta.
- Ghosh**, A. M. N., B.Sc., A.R.C.S., Superintending Geologist, Geological Survey of India, 27, Chowringhee, Calcutta.
- Ghose**, Asoke Kumar, B.E.E., Scientific Syndicate, P. N. Sinha Road, Patna-6
- Ghosh**, B. N., M.Sc., Ph.D., etc., Dept. of Chemical Technology, University of Bombay, Matunga, Bombay-19.
- Ghosh**, B. N., D.Sc., F.N.I., Palit Professor of Chemistry, Dept. of Pure Chemistry, University College of Science, 92, Upper Circular Road, Calcutta-9.
- Ghosh**, B. N., M.B.E., F.R.I.P.G.S., L.M., F.R.S., F.G.M.F., Prof. of Pharmacology, Carmichael Medical College, 2F, Garcha 1st Lane, Calcutta.
- Ghosh**, (Dr.) B. N., Office of the Serologist, School of Tropical Medicine, Calcutta.
- Ghosh**, Ban Behari, M.Sc., Demonstrator of Physiology, Calcutta National Medical College, 32, Gorachand Road, Calcutta.
- Ghosh**, Bejoy Gopal, 28-B, Debendra Ghosh Street, Calcutta.
- Ghosh**, Benoy Lal, C.E., Councillor, Calcutta Corporation, 26, Chowringhee Road, Calcutta.
- Ghosh**, Bidhu Bhushan, B.E., C.E., A.M.I.E., M.Amer.Soc.R.E., A.M.Amer.Soc.H.V.E., Deputy Director of Engineering, Govt. of India, 47, Southern Avenue, Calcutta-29.
- Ghosh**, Birendra Nath, M.Sc., Dept. of Statistics, Prof., Presidency College, Calcutta.
- Ghosh**, Chandra Sekhar, S.M. (M.I.T.), M.A.I.E.E., M.I.E.S.A., Prof. of Electrical Engineering, Dept. of Power Engineering, Indian Institute of Science, Bangalore-3.
- Ghosh**, G. S., Government College of Jeypore, Koraput, Orissa.
- Ghosh**, H., M.B., M.S.P.E., Scientific Director, M/s. Standard Pharmaceutical Works Ltd., 67, Dr. Suresh Sarkar Road, Calcutta-14.
- Ghosh**, Sir J. C., Kt., D.Sc., F.N.I., Vice-Chancellor, University of Calcutta, Calcutta.
- Ghosh**, K. D., M.A., D.Litt., Dip-in-Ed., Barrister-at-Law, Principal, David Hare Training College, 25-3, Ballygunge Circular Road, Calcutta.
- Ghosh**, Lalmohan, B.E.E., A.M.I.E., Electrical Power Engineer, Shift Charge Engineer, The Calcutta Electric Supply Co., 38, European Asylum Lane, Calcutta-16.
- Ghosh**, Madan Mohan, M.Sc., 29/2, School Row, Calcutta-25
- Ghosh**, Manindra Kumar, Tata Research Laboratory, P.O. Burmanines, Jamshedpur.
- Ghosh**, N. L., M.Sc., D.Phil., Senior Professor of Mathematics, Presidency College, Calcutta.
- Ghosh**, Naresh Chandra, M.Sc., D.Phil., Dept. of Physiology, Presidency College, Calcutta-7.
- Ghosh**, Nripendra Nath, M.Sc., 15A, Beltala Road, Calcutta-26.
- Ghosh**, (Dr.) P. K., Geological Survey of India, 27, Chowringhee, Calcutta-13.

- Ghose, P. K.**, A.M.I.Min.E., A.M.G.I., F.G.M.S., Mining Engineer, Narainkuri Bungalow, Raniganj, P.O. Egra, E. I. Rly.
- Ghosh, Parimal Kanti**, Dept of Applied Mathematics, University College of Science, 92, Upper Circular Road, Calcutta.
- *Ghosh, Prasanta Kumar** M.B., D.T.M., M.R.C.P., F.C.C.P., Senior Physician, Mayo Hospital & R G Kar Medical College Hospital, 22, Nilmoni Mitter Street, Calcutta-6
- Ghosh, (Sm.) Prativa**, B.A., Signet Press, 10/2, Elgin Road, Calcutta-20.
- Ghosh, Rabindra Mohan**, B.Sc., Bengal Immunity Research Institute, 39, Lower Circular Road, Calcutta-16.
- Ghosh, S.**, D.Sc., Dept. of Applied Mathematics, University College of Science, 92, Upper Circular Road, Calcutta.
- Ghosh, S.**, D.Sc., F.N.A.Sc., Reader, Chemistry Dept., University of Allahabad, Allahabad.
- Ghosh, S. K.**, B.Sc., F.S.A.A., F.C.A., 2/2, Elgin Road, Calcutta-20.
- Ghosh, S. K.**, Managing Director, Instrument Research Laboratory Ltd., 309, Bowbazar Street, Calcutta-12.
- Ghose, S. K.**, Deputy Director, Bihar Institute of Hydraulic & Allied Research, Patna-1.
- Ghose, S. K.**, M.Sc., Geologist, Hindusthan Minerals & Natural History Specimens Supply Co., 39, Russa Road, Calcutta-33.
- Ghosh, S. M.**, M.B., Asst. Prof. of Medical Entomology, School of Tropical Medicine, Chittaranjan Avenue, Calcutta.
- Ghosh, (Dr.) S. N.**, B.C.P.W. Ltd., 164, Maniktollah Main Road, Calcutta
- Ghosh, S. S.**, M.Sc., F.B.S., Assistant Wood Technologist, Forest Research Institute, P.O. New Forest, Dehra-Dun.
- Ghose, Sachindra Kumar**, B.E.E., A.M.I.E., S.D.O., Electrical Sub-Division, Chinsurah.
- Ghosh, Sachindra Nath**, A.M.E.E., Electrical Contractor, 90, Bechu Chatterjee Street, Calcutta
- Ghosh, Satish Chandra**, M.A., Alderman, Calcutta Corporation, Chairman, Town Planning & Improvement Committee and Treasurer, Calcutta University, 13/1, Ishwar Mill Lane, Calcutta-6.
- Ghosh, Suchit Kumar**, B.E., A.M.I.E., Executive Engineer (W. & B.), West Bengal Govt, City Division, Writers' Building, Calcutta.
- Ghosh, Sudev Bhusan**, M.Sc., Head, Dept. of Biology, Bangabasi College, 19, Scott Lane, Calcutta-9.
- Ghose, Sudhir Kumar**, M.B., D.T.M., Chief Analyst, Calcutta Corporation, 23/1, Beniatola Street, Calcutta.
- Ghose, T.**, Statistician, United Commercial Bank Ltd., 2, Royal Exchange Place, Calcutta.
- Ghosh, T. K.**, B.Sc., Engg., Consulting Engineer, 1/B, Old Post Office Street, Calcutta-1.
- Ghosh, T. K.**, Manager, M/s. B. K. Paul & Co., Ltd., 1, Bonfield Lane, Calcutta.
- Ghosh, (Dr.) T. N.**, Publicity Officer, Bengal Chemical & Pharmaceutical Works Ltd., 164, Maniktollah Main Road, Calcutta.
- Ghosh, T. N.**, D.Sc., Bengal Immunity Research Institute, 39-B, Lower Circular Road, Calcutta-16.
- Ghosh, Tarit Kumar**, M.D., Physician, R G. Kar Medical College, 60, Baje Shibpur Road, Howrah.
- Ghoshal, Aniya Kumar**, M.Sc., Dept. of Chemistry & Biochemistry, Nilratan Sarkar Medical College, Calcutta.
- Ghoshal, R.**, M.Sc., M.B., D.T.M., Hon'y. Lecturer, Post Graduate Dept. of Physiology, University College of Science, 121B, Grey Street, Calcutta-5.

- Ghosh Dastidar**, Girindra Nath, Overseer, Water-works Dept., Corporation of Calcutta, 34A, Manmatha Dutta Road, Calcutta-37.
- Griffin and Tatlock (India) Ltd.**, B-5, Clive Building, Post Box No. 2136, Calcutta-1.
- Greval**, S. D. S., B.Sc., M.D., Ch.B., D.P.H., I.M.S., Imperial Serologist and Chemical Examiner to the Govt. of India, School of Tropical Medicine Building, Calcutta.
- Gill**, P. S., Ph.D., F.N.I., Professor of Physics, Muslim University, Aligarh.
- Godbole**, Anantrao Narayanrao, Lecturer in Chemistry, S. J. Science Institute, Baroda-1.
- Godbole**, (Prof.) R. D., Dept. of Physics, Ramnarayan Ruia College, Bombay-19.
- Godbole**, S. N., Rao Sahab, M.Sc., Dhantoli, Nagpur.
- Gogate**, D. V., M.Sc., Ph.D., Professor of Physics, Baroda College, Baroda.
- Goil**, M. M., M.Sc., F.Z.S., F.R.M.S., Dept. of Zoology, Bareilly College, Bareilly.
- Gokhale**, A. G., M.A., B.Sc., F.R.I.C., A.I.Sc., 'Prakash', Tilakwadi Sharanpur Road, Nasik.
- Gokhale**, Shankar Kashinath, B.A., M.Sc., A.I.I.Sc., F.R.I.C., 'Gopalsmriti', 38, Vijaynagar Colony, Tilak Road, Poona-2.
- Gokhal**, (Prof.) S. D., Physics Dept., S. P. College, Poona-2.
- Gollerkeri**, P. G., M.D., Prof. of Pathology, Pathology Dept., B. J. Medical College, Poona-1.
- Gonzalves**, (Mrs.) E., B.A., M.Sc., Dept. of Botany, Institute of Science, Mayo Road, Fort, Bombay.
- Gooptu**, Asoka, M.A., 87, Rash Behari Avenue, Calcutta-26.
- Gopalakrishnan**, V. R., Rao Sahib, G.M.V.C., P.G., Asst. Research Officer, Indian Veterinary Research Institute, Mukteswar-Kumaun.
- Goswami**, M. N., D.Sc., Head of the Dept. of Applied Chemistry, University College of Science, 92, Upper Circular Road, Calcutta.
- *Goswami**, S. K., B.E., Asst. Engineer-in-charge, C.E.'s Drawing Office, I. & W. Directorate, Writers' Building, Calcutta.
- Gowda**, S. Samba, Lecturer in Geology, Central College, Bangalore-1.
- Guha**, Amiya, B.Sc., A.M.I.E., Engineer, G.E.S.C. Ltd., 244C/1, Vivekananda Road, Calcutta-9.
- Guha**, B. C., Ph.D., D.Sc. (London.), F.N.I., University College of Science, 92, Upper Circular Road, Calcutta-9.
- Guha**, Dilip Kumar, B.Ch.E., M.Tech., Chemical Engineer, Chemical Engineering Dept., Indian Institute of Technology, Kharagpur.
- Guha**, H. K., B.Sc., Director, Geologists Syndicate Ltd., 137, Canning Street, Calcutta.
- Guha**, P. C., D.Sc., F.N.I., C.I.T. Plot No. 536, Raja Basanta Roy Road Extension, Calcutta-29.
- Guha**, Priya Bhusan, B.E., C.E., A.M.I.E., City Architect, Corporation of Calcutta, Surendranath Banerjee Road, Calcutta.
- Guha**, Subodh Chandra, B.Sc., Bengal Immunity Co., Ltd., Baranagar Post, 24-Parganas.
- Guha**, (Sm.) U., M.Sc., Dept. of Anthropology, Govt. of India, Indian Museum, Calcutta-13.
- Guleri**, (Major) J. S., E.D., M.A., LL.B., P.A.S., Chief Statistical Officer, Govt. of Rajasthan, Dept. of Commerce & Industry, Bureau of Statistics, Jaipur.
- Gulati**, Hans Raj, M.Sc., House No. 1777, Nai Walli Gali No. 53, Karol Bagh, New Delhi.
- Gulati**, (Dr.) K. C., Organic Chemist, Indian Agriculture Research Institute, New Delhi-12.
- Gupta**, A. K., B.A., C/o. S. K. Gupta, I.A.S., 44/2, Ironside Road, Calcutta.

- Gupta**, (Mrs.) Anusya, C/o. Dr. T. C. Gupta, Professor of Physiology, Darbhanga Medical College, Laheriasarai
- Gupta**, Balai Ch., C/o. Shri B. Gupta, Bengal Immunity Research Institute, 39, Lower Circular Road, Calcutta-16.
- Gupta**, Bireswar, M.Sc., Pharmacologist, Bengal Immunity Research Institute, 39, Lower Circular Road, Calcutta-16.
- Gupta**, D. P., Lecturer in Mathematics, University of Saugor, Sagar.
- Gupta**, Hanraj, M.A., Ph.D., P.E.S., Punjab University College, Hoshiarpur.
- Gupta**, (Mrs.) Hashi, M.A., 9/6/1E, Pearymohan Sen Lane, Calcutta.
- *Gupta**, J. C., M.B., M.D., Cardiologist, R. G. Kar Medical College Hospital, Calcutta-4
- Gupta**, (Dr.) Jagannath, Asst. Director, National Chemical Laboratory, Poona-7.
- Gupta**, Kalyankar, B.Sc., 16, Netaji Subhas Road, Calcutta.
- Gupta**, L., Chief Technical Adviser, Manager, The Hyderabad, Chemicals & Fertilizers Ltd., Belampalli, Hyderabad State.
- Gupta**, M., B.Com., C.A., Partner, S. K. Ghosh & Co., 10, Old Post Office Street, Calcutta-1.
- Gupta**, M. P., B.E., Asst. Chief Engineer, Philips Electrical Co. Ltd., Philips House, Calcutta-20.
- Gupta**, M. G., B.Sc., F.H.B.T.I., etc., Head of the Chemistry & Industrial Chemistry, C. M. Singh Govt. Polytechnic, Baurala, Meerut.
- Gupta**, Madan Lal, C/o. M/s. Scientific Apparatus Manufacturing Co., 388/94, Sheikh Memon Street, Bombay-2.
- Gupta**, P. D., Lecturer in Zoology, University of Lucknow, Lucknow.
- Gupta**, R. D., M.Sc., Physics Dept., R. R. College, Bombay-19
- Gupta**, R. N., Associated Instrument Manufacturers (India) Ltd., B-5, Clive Buildings, P.O. Box No. 2136, Calcutta
- Gupta**, S., M.Sc., P.R.S., F.N.I., Reader in Theoretical Physics, Muslim University, Aligarh.
- Gupta**, Subodh Chandra, M.B., Asst. Surgeon Supdt., B.I.S.N. Co. Ltd., 16 Strand Road, Calcutta.
- *Gupta**, T. C. M.D., Ph.D., Prof. of Physiology, Darbhanga Medical College, Laheriasarai
- Gupta**, Tamohar, Hind Lamp Works Ltd., Shikohabad
- Gyani**, B. P., M.Sc., Ph.D., Prof. & Head of Physical Chemistry, Science College, The University, Patna-5.

H

- Hai**, M. A., Khan Shahib, M.D., M.R.C.P., T.D.D., Lecturer in Medicine, P. W. Medical College, Patna.
- Haldar**, C. K., M.Sc., A.M.A.E., A.M.I.Prod.E., Asst. Superintendent of Development, Technical Development Establishment (Weapons), Gun and Shell Factory, Calcutta-2.
- Halder**, Ghanasyam, B.Sc., Research Worker, Jute Agriculture Research Institute, Barrackpore, 24 Parganas
- Hardikar**, S. W., M.D., M.R.C.P., Abhas, A-10-468, Hardikar Bagh, Himayatnagar, Hyderabad-Dn.
- Hargolal & Sons**, Hargolal Road, Ambala Cantt.
- Harwalkar**, V. R., Research Scholar, Central Laboratories for Scientific & Industrial Research, Hyderabad-Dn.
- Harrison**, C. J., B.Sc., O.B.E., Chief Scientific Officer, Indian Tea Association, Tocklai Experimental Station, Cinnamara P.O., Assam.

- Hattiangadi, R. R.**, B.A., M.Sc., Ph.D., D.I.C., The Associated Cement Co. Ltd., 1, Queens Road, Fort, Bombay.
- Hatwalne, Shri V. G.**, M.Sc., 1st R.B.D., Laxminarayan Fellow, Dept. of Biochemistry, Nagpur University, Nagpur.
- Haworth, (Dr.) Alfred John**, Senior Staff Geologist, American Overseas Petroleum Ltd., 380, Madison Avenue, New York-17, N.Y., U.S.A.
- Hazra, A. K.**, M.B.B.S., D.T.M., Senior Bacteriologist, Haffkine Institute, Parel, Bombay-12.
- Hazra, P. C. D.**, B.Sc., A.R.C.S., A.R.S.M., F.G.S., Senior Geologist, Geological Survey of India, 27, Chowringhee, Calcutta-13.
- Hirachand, Lalchand**, Construction House, Wittat Road, Ballard Estate, Bombay.
- Hiregaudar, L. S.**, B.Sc., G.B.V.C., Lecturer, Bombay Veterinary College, Parel, Bombay.
- Hirur, N. Y.**, C/o. Shri D. Subba Rao, Leelasadan, Sidhanth Road, Baroda.
- Hora, (Miss) Lahita**, C/o. Dr. S. L. Hora, 1, Sudder Street, Calcutta-13.
- *Hora, Sunder Lal, Rai Bahadur**, D.Sc. (Punjab et Edin.), F.L.S., F.Z.S., F.R.S.E., F.N.I., F.R.A.S.B., Director, Zoological Survey of India, Jabakusum House, 34, Chittaranjan Avenue, Calcutta.
- Hora, (Mrs.) Vidya**, C/o. Dr. S. L. Hora, 1, Sudder Street, Calcutta-13.
- Hunday, A. S. L. S.**, Geological Survey of India, 27, Chowringhee, Calcutta-13.
- Hussain, Main Afzal**, 51/3, Lawrence Road, Lahore.
- Husain, Dildar**, B.E., M.I.E., Retired Chief Engineer, Irrigation, "Raiaz", 268, Jubilee Hill, Khairatabad P.O., Hyderabad-Dn.
- Hussain, Syed**, M.Sc., Ph.D., Principal, Nizam's College, Principal's Lodge, Nizam College, Hyderabad-Dn.
- *Hutton, J. H.**, C.I.E., M.A., D.Sc., I.C.S., F.N.I., F.R.A.S.B., The Old Rectory, New Radnor, Presteign, Radnor, U.K.
-
- Ilse, (Dr.) Dora**, Reader & Head, Zoology Dept., University of Poona, Poona.
- Indian Association for the Cultivation of Science**, The, Jadavpur, Calcutta-32.
- Indian Central Jute Committee**, 4, Hastings Street, Calcutta.
- Indian Science News Association**, 92, Upper Circular Road, Calcutta-9.
- Indian Veterinary Journal**, 26, Wallajah Road, Madras-2.
- Indian Veterinary Research Institute**, The Director, Mukteswar-Kumaun, U.P.
- Indian Wood Products Co., Ltd.**, Bareilly, Izatnagar, U.P.
- Inamder, N. B.**, Zoology Dept., Institute of Science, Fort, Mayo Road, Bombay.
- Irani, (Miss) R. J.**, "Roshni", Off. Cathedral Road, Madras-6.
- International Agencies**, Lucky Mansion, 3rd Floor, 79, Ganga Street, Fort, Bombay-1.
- Iyer, (Dr.) B. H.**, Lecturer in Organic Chemistry, Indian Institute of Science, Bangalore-3.
- Iyer, K. Sitarama**, M.A., Chalai Street, Trivandrum, Travancore.
- Iyer, L. A. N.**, Rao Bahadur, Ph.D., D.Sc., 10/21, Ponnuranga Mudalior Road, R. S. Puram Post, Coimbatore, S.I.
- Iyer, R. S. Ramasubba**, B.A., 2 & 4/9, Broadway, Madras-1.
- Iyer, S. G.**, Head of the Divn Poultry Research, Indian Veterinary Research Institute, Izatnagar.
- Iyer, S. Narayana**, M.A., A.T.T.Sc., F.R.I.C., Government Analyst, King Institute, Guindy, Madras-15.
- Iyer, S. N. Venkatarama**, Provincial Marketing Officer, Khabel Mansions, Madras-2.
- Iyer, S. Rama**, K.I.H., L.M. & S., Retd. Civil Surgeon (Burma Service), Deva-rayasasamudaram Post, Via Kolar, Mysore Province

- Iyer, V. Rama**, B.Sc. Met., A.I.M., M.I.I.M., Metallurgist, M/s. Bhartia Electric & Steel Co., 8, Swinhoe Street, Ballygunge, Calcutta.
- Iyer, M. O. P.**, M.A., Ph.D., F.L.S., F.N.I., Retd., Director, University Botany Laboratory, 71, V. R. Pillai Street, Madras.
- Iyengar, (Dr.) M. S.**, Central Laboratories for Scientific & Industrial Research, Hyderabad-Dn

J

- Jadhav, Ganpatrao Vishramrao**, B.A., M.Sc., Ph.D., A.I.C., Prof. of Organic Chemistry, The Institute of Science, Mayo Road, Bombay.
- Jagannathan, P.**, M.A., India Meteorological Dept., Poona-5.
- Jain, A. L.**, M.Sc., Research Asstt., Dept. of Physics, University of Delhi, Delhi-8
- Jain, A. P.**, M.Sc., Lecturer in Geology, Patna University, Patna.
- Jain, D. P.**, C/o Instrument & Chemicals Ltd, Ambala Cantt.
- Jain, M. S.**, M.Sc., Geological Survey of India, 27, Chowringhee, Calcutta.
- Jain, Prithi Raj**, Proprietor, Jain Scientific Glass Works, Opp Jain Mandir, Ambala Cantt, Punjab
- Jain, Raj Kumar**, Manager, Instruments & Chemicals Ltd, Main Road, Trivandrum-1, Madras
- Jain, Sukhbir Prasad**, M.D., F.R.C.S., Professor of Anatomy, Agra Medical College, Agra.
- ***Jalota, S.**, M.A., D.Phil., Dept. of Psychology, Banaras Hindu University, Banaras
- Jambunathan, M. V.**, Dept. of Statistics, Maharaja's College, Mysore
- Janaki, (Miss) V. A.**, Eranampalam House, Kallat, Malabar.
- Jatkar, S. K. K.**, D.Sc., F.I.I.Sc., F.I.C., F.Inst.P., Dept. of Chemistry, University of Poona, Poona
- Javadekar (Prof.), P. S.**, Head of the Dept. of Chemistry, Willingdon College, Vishrambag, (Sangli), S. Railway, Dist. South Satra, Bombay State.
- Jay Engineering Works**, The, 183A, Prince Anwar Shah Road, Dhakuria, Calcutta-31.
- Jhaveri, I. H.**, Sultanpura, Baroda.
- ***Jhingran, Anant Gopal**, M.Sc., Ph.D., Superintending Geologist, Geological Survey of India, Ali Manzil, Wala Qadar Road, Lucknow.
- Jnanananda, (Dr.) Salgmi**, National Physical Laboratories, University Buildings, Delhi.
- Joglakar, G. D.**, Asstt Director, National Physical Laboratory, Hill Side Road, New Delhi.
- Jolly, A. P.**, Instruments & Chemicals Ltd., Amballa Cant.
- Jolly, (Mrs.) Shubh**, C/o Technical Director, Instruments & Chemicals Ltd., Amballa Cantt.
- Jones, S.**, D.Sc., Central Marine Fisheries Research Station, West Hill, Calicut-5
- Johri, B. M.**, D.Sc., Reader, Dept. of Botany, University of Delhi, Delhi.
- Joshi, A. C.**, D.Sc., F.N.I., Principal, Govt. Training College for Teachers, Jullundur.
- ***Joshi, B. B.**, L.T.M. (Hons.), A.T.I. (Manch.), Textile Technologist, Director, New India Instruments Ltd., Engineering & Agencies Ltd., Textile Stores (Baroda) Ltd., 81, Alokपुरी, Baroda.
- Joshi, Bhalchandra B.**, Research Asstt., Botany Dept., Faculty of Science, S. J. Institute, Baroda.
- Joshi, C. B.**, M.A., Nowrosjee Wadia College, Poona-2.
- Joshi, N. S.**, B.E., M.I.E., M.R.San.I., Rao Bahadur, Retd. Supdt. Engineer, (Bombay P.W.D.), 1287, Shivajee Nagar, Poona.

- Joshi, N. V.**, B.A., M.Sc., L.Ag., Maharashtra Association for the Cultivation of Science, Law College Buildings, Poona-4.
- Joshi, S. S.**, M.Sc., Central Laboratories for Scientific & Industrial Research, Hyderabad-Dn.
- Joshi, S. S.**, M.Sc., D.Sc., University Professor & Head of the Chemistry Dept., Hindu University, Banaras.
- Joshi, T. N.**, Faculty of Technology, M. S. University, Baroda.
- Joshi, (Mrs.) Taraben B.**, 81, Alakapuri, Baroda.
- Jyoti, (Miss) D. N.**, Demonstrator in Zoology, Faculty of Science, M. S. University, Baroda.

K

- Kabadi, M. B.**, M.Sc., Ph.D., Institute of Science, Mayo Road, Fort, Bombay.
- Kabasi, Sunil Kumar**, B.E., M.E., Resident Engineer, Drainage, Calcutta Corporation, 8, Bhairab Mukherjee Lane, Calcutta-4.
- Kabi, T.**, M.Sc., Lecturer in Botany, Ravenshaw College, Cuttack-3.
- Kalamkar, (Dr.) R. J.**, Director of Agriculture, Research Education, Madhya Pradesh, Nagpur.
- *Kalapesi, A. S.**, B.A., B.Sc., D.I.C., Ph.D., F.G.S., F.R.G.S., St. Xaviers College, Cruickshank Road, Bombay.
- Kalapesi, R. M.**, G.B.V.C., B.V.S., 'Gulistan' 802/A, Kingsway, Dadar, Bombay-14.
- Kalyansundaram, V.**, M.A., L.T., Asst. Director, India Bureau of Mines & Power, Central Secretariat, New Delhi.
- Kane, Govind Pandurang**, M.Sc., Ph.D., D.I.C., Dept. of Chemical Technology, Bombay University, Bombay-19.
- Kanga, D. D.**, I.E.S. (Retd.), Theosophical Society, Adyar, Madras.
- Kapoor, L. D.**, Chief Protanist, Drug Research Laboratory, Jammu Tawi, Kashmir.
- *Kapoor, R. C.**, M.Sc., D.Phil., F.N.A.Sc., 44, Kailash, Kanpur.
- Kapoor, Radha Shyam**, C/o. R. N. Kapoor & Co., 47/7, Bagia Maniram, Kanpur.
- Kapoor, S. N.**, Research Chemist, H. B. Technological Institute, Kanpur.
- Kapur, (Capt.) A. N.**, M.A., B.A., P.E.S. (I), Head of the Dept. of Geography, Punjab University, Govt. College, Ludhiana.
- Kapur, (Dr.) A. P.**, Entomology Section, Zoological Survey of India, 34, Chittaranjan Avenue, Calcutta-12.
- Kapur, L. Dev Raj**, Sambhunath Chemical Works Ltd., H. 32, Connaught Circus, New Delhi.
- Kapur, P. L.**, Dept. of Physics, University of Delhi, Delhi.
- Kappanna, A. N.**, D.Sc., Prof. of Chemistry, College of Science, Nagpur.
- Kar, (Dr.) A. B.**, M.Sc., Ph.D., F.P.Sc.A. (U.S.A.), Senior Scientific Officer, Division of Pharmacology, Central Drug Research Institute, Chatter Manzil Palace, Lucknow.
- Kar, B. C.**, Reader in Education, Gauhati University, Gauhati.
- Kar, (Dr.) B. K.**, M.Sc., Ph.D., F.R.S., Physiologist, Jute Agriculture Research Institute, 'Lalkothi', Barrackpore.
- Kar, K. C.**, D.Sc., Head of the Dept. of Physics, Presidency College, Calcutta.
- Kar, Nisith Ranjan**, M.Sc., F.R.G.S., Dept. of Geography, Presidency College, Calcutta.
- Karandikar, (Dr.) Gopal K.**, Prof. of Pharmacology, Medical College, Baroda.
- Karmakar, Profulla Ch.**, Physiology Dept., University College of Science, 92, Upper Circular Road, Calcutta.
- *Karve, D. D.**, M.Sc., Ph.D., A.I.I.Sc., Principal & Prof. of Chemistry, Fergusson College, Law College Road, Poona.

- *Karve, (Mrs.) I.**, C/o. Dr. D. D. Karve, Principal, Ferguson College, Law College Road, Poona.
- Kasliwal, R. M.**, M.D., M.R.C.P., D.T.M. & H., Prof. of Medicine, S. M. S. College, Jaipur.
- Kashthuri, Sri A. K.**, M.A., M.Sc., F.G.S., M.M.G.I., F.G.M.S., Asst. Prof. of Geology, Presidency College, Triplicane, Madras.
- Katre, S. M.**, Director, Deccan College Post Graduate & Research Institute, Poona.
- Kaushal, (Dr.) R. L.**, Deputy Director, Research & Disease Control, M. B. Vaccine & Research Institute, Gwalior.
- Kaw, (Dr.) B. L.**, M.B., M.Sc., Ph.D., Prof & Head, Zoology Dept., Sri Pratap College, Srinagar.
- Kayastha, S. L.**, Prof., Geography Dept., Hindu University, Banaras.
- Kehar, N. D.**, M.Sc., Sc.D., Officer-in-charge, Animal Nutrition Section, Veterinary Research Institute, Izatnagar, U.P.
- Kelkar, K. V.**, Prof. of Geology, Bunglow No. 6, Fergusson College, Poona.
- Kekar, V. R.**, 539, Narayan Peth, Poona.
- Khambata, F. S.**, B.Ag., M.Sc., G.V.B.S., Ph.D., Vice-Principal & Prof. of Animal Husbandry, Bombay Veterinary College, Parel, Bombay.
- Khambata, (Mrs.) F. S.**, B.Sc., T.D., C/o. Mrs. Gazdar, Family House, 794, Parsi Colony, Dadar, Bombay-14.
- Khan, A. R.**, Agronomist, Indian Agriculture Research Institute, New Delhi.
- Khan, Aziz Dulah**, M.Sc., Ph.D., Deputy Director of Agriculture, 'Bilsa House', Tulsi Das Marg, Lucknow.
- Khan, (Dr.) Mohemmed Qadiruddin**, Govt. Engomologist, Main Farm, Himayat-sagar, Hyderabad-Dn.
- Khan, Reayat**, M.Sc., Ph.D., Botany Dept., Aligarh University, Aligarh.
- Khanolkar, (Dr.) V. R.**, Director, Cancer Research Centre, Tata Memorial Hospital, Parel, Bombay.
- Khanna, K. L.**, B.Sc., Assoc. I.A.R.I., F.A.Sc., Director, Sugarcane Research & Development, Pusa.
- Khanna, Shib Kumar**, Presidency Magistrate, Calcutta, Councillor, Calcutta Corporation, 11, Harrison Road, Calcutta.
- Kharkwal, A. D.**, Lecturer in Geology, Lucknow University, Lucknow.
- Khastgir, S. R.**, D.Sc., F.N.I., Ph.D., M.I.R.E., Head of the Dept. of Physics, Banaras Hindu University, Banaras.
- Khedkar, V. R. R.**, Geological Survey of India, 27, Chowringhee, Calcutta.
- *Khera, B. R.**, A.M.I.B.E., A.I.S.E., Deputy Commandant, Royal Indian Engineers, Garrison Engineer, Military Engineering Service, No. 2, Ulsoor Road, Bangalore.
- Khorana, M. L.**, B.S., B. Pharmacy, M.S., Indian Journal of Pharmacy, Dept. of Chemical Technology, Matunga, Bombay-19.
- Kichhu, (Dr.) P. K.**, Prof. of Physics, Dept. of Physics, University of Delhi, Delhi.
- Kidwai, (Dr.) A. R.**, M.Sc., Ph.D., Reader in Chemistry, Muslim University, 7, University Road, Aligarh.
- Kilpady, Sripada**, M.Sc., F.G.S., F.A.Sc., F.N.I., Head of the Dept. of Geology, Law College Building, Nagpur University, Nagpur.
- Kishen, K.**, Chief Statistician to the Govt. of U. P., Dept. of Agriculture, Uttar Pradesh, Chota Chutter Manzil, Lucknow.
- Kishore, Nand**, C.E., A.M.I.E., Proprietor of Hargolal & Sons, Hargolal Road, Ambala Cantt.
- *Kishore, Ram**, B.A., A.M.I.E., 1, Sundarbagh, Lucknow.
- Kishore, Shiva**, M.Sc., Research Dept., All India Radio, Curzon Road Barracks, New Delhi.
- Kochhar, B. D.**, D.Sc., F.R.I.C., Provincial Public Analyst, Ambala Cantt.

- Konar, Nalini Ranjan, M.D., M.R.C.P., Associate Prof. of Medicine, N. R. Sarkar Medical College, Calcutta.**
- Kondaiah, (Dr.) Evani, M.Sc., Fil. Lic., Fil. Dr. (Stock.), Tata Institute of Fundamental Research, Apollo Pier Road, Bombay.**
- *Konoria, Gopi Krishna, Merchant & Banker, Post Box No. 7, Chowk, Patna City.**
- Korgaokar, M. N., M.A., Prof. & Head of the Mathematics Dept., M. N. College, Visnagar.**
- Korgaonkar, (Dr.) K. S., Indian Cancer Research Centre, Tata Memorial Hospital, Parel, Bombay.**
- Kolhatkar, G. B., M.A., A.I.I.Sc., Prof. of Chemistry, Prof. Kolhatkar's Bungalow, 759/88, Shiwaji Nagar, Deccan Gymkhana, Poona-4.**
- *Kosambi, D. D., D.Sc., Tata Institute of Fundamental Research, 53, Peddar Road, Bombay.**
- Kothare, A. N., Prof., Chemistry Dept., St. Xaviers College, Cruickshank Road, Bombay-1.**
- Kothari, D. S., D.Sc., Ph.D., F.N.I., Scientific Adviser, Ministry of Defence, New Delhi.**
- Krishnamurty, D., G.M.V.C., B.V.Sc., Asstt. Professor of Bacteriology, U. P. College of Veterinary Science & Animal Husbandry, Mathura, U.P.**
- Krishnamurthy, D. V. G., B.Sc., B.Ag., M.S., Deputy Director of Agriculture (Food Products), Himayatnagar, Hyderabad-Dn.**
- Krishnamurthy, K. V., Extra Asstt. Director, Central Water & Power Commission, Curzon Road, New Delhi.**
- Krishnan, Sir K. S., F.R.S., Director, National Physical Laboratory, Hill Side Road, New Delhi.**
- Krishnan, K. V., M.B.B.S., D.B., F.R.C.P., D.Sc., F.N.I., F.R.S.(E.), Director, All India Institute of Hygiene & Public Health, 110, Chittaranjan Avenue, Calcutta.**
- *Krishnan, M. S., M.A., Ph.D., A.R.C.S., D.I.C., F.N.I., Director, Geological Survey of India, 27, Chowringhee, Calcutta.**
- Krishnan, (Dr.) R. S., D.Sc., Ph.D., Dept. of Physics, Indian Institute of Science, Malleswaram P.O., Bangalore.**
- Krishnaswami, K. R., D.Sc., Industrial Chemist to Govt. of Bihar, Secretariat, Patna.**
- Krishnaswami, V. D., M.A., Dip. Arch. (Cantab.), Supdt., Dept. of Archeology, South-Western Circle, Poona-4.**
- Kulkarni, (Dr.) C. V., Taraporevala Aquarium, Asstt. Director of Fisheries, Netaji Subhas Road, Bombay-2.**
- Kulkarni G. S., M.Ag., Station Road, Dharwar.**
- Kulkarni, S. N., M.Sc., Research Asstt., Shriniketan Saptapur, Dharwar, Bombay State.**
- Kulshreshta, L. P., Dept. of Psychology, D. A. V. College, 11/225, Souterganj, Kanpur.**
- Kumar, B. K., B.E.E., Asst. Electrical Engineer, C.P.W.D., Calcutta Air Port, Dum Dum, 28, Mohendra Sircar Street, Calcutta-12.**
- Kumar, Jasoda, M.Sc., Psychologist, C/o. Biological Supply Concern, 5A, Kali Dutta Street, Calcutta-5.**
- Kumar, G. D., M.Sc., Research Associate, Dept. of Anthropology, Govt. of India Indian Museum, Calcutta.**
- Kumari, Sulakashna, C/o. Shri Jagnandan Lal, 22-A, Edmonstone Road, Allahabad.**
- Kundu, Anil Kumar, M.Sc., Research Worker, Jute Agriculture Research Institute, Barrackpore.**

- *Kundu, B. C., M.A., Ph.D. (Leeds), F.L.S. (Lond.), F.N.I., Director, Agricultural Research Institute, Barrackpore.
- Kundu, P., Lecturer, Communication Engineering Dept., Indian Institute of Technology, Kharagpur.
- Kuriyan, (Dr.) George, B.A., Ph.D., B.Sc., Prof. of Geography, University Examination Hall, Marina, Madras-5.
- Kurulkar, (Dr.) G. M., Prof. of Anatomy, S. G. S. Medical College, Parel, Bombay 1.
- Kutar, P. H., B.A., B.Sc., M.S., Met. E. (Edin.), General Manager, Tata Iron & Steel Co Ltd., Jamshedpur.

L

- Lahiri, (Dr.) A., Asst. Director, Fuel Research Institute, Digwadi, P.O. Jealgora, Dt. Manbhum.
- Lahiri, A. N., B.Sc., B.Sc.Engg., A.M.I.E., Superintending Engineer, Dharmal, Damodar Valley Corporation, Anderson House, Alipore, Calcutta-27.
- Lahiri, D. C., M.B. (Cal.), Ph.D. (Bom.), D.T.M. & H. (Eng.), Dip. Bact. (Lond.), Professor of Bacteriology & Pathology, School of Tropical Medicine, Calcutta-12.
- Lahiri, (Major) J. M., M.R.C.V.S., F.Z.S., Principal, Bengal Veterinary College, Calcutta-37.
- Lahiri, M. N., (Dr.), Associate Prof. of Microbiology, All India Institute of Hygiene & Public Health, 110, Chittaranjan Avenue, Calcutta.
- Lakshmanan, C. K., Lt.-Col., L.M.S. (Mad.), M.R.C.S., D.T.M. & H. (Lond.), D.P.H. (Eng.), Director General, Health Services, New Delhi.
- Lakshanpal, R. N., Birbal Sahni Institute of Palaeobotany, Lucknow.
- Lakshmipathy, B. M., B.E., M.E., M.R.A.S.E., Dy. Director of Agriculture, Chepauk, Madras-5.
- Lal, (Dr.) D. N., M.A., Ph.D. (Edin.), F.S.S., Head, Statistics Dept., University of Patna, Patna.
- Lal, (Mrs.) D. N., New Dak Bunglow Road, Patna.
- Lal, Harkishan, Manager, The Oriental Science Apparatus Workshop, Ambala Cantt.
- Lal, (Dr.) J. B., H.B. Technological Institute, Nawabgunj, Kanpur.
- Lal, (Dr.) K. B., M.Sc., Ph.D. (Edin.), Entomologist to Govt., U.P., Kanpur.
- Lal, (Dr.) M. B., Reader in Zoology, Lucknow University, Lucknow.
- Lal, (Dr.) N. Ram, City College, Hyderabad-Dn.
- Lal, Sham, C/o. Scientific Glass Works Ltd., 2539, Bengali Mohalla, Amballa Cantt.
- Lal, Shyam Behary, M.B.B.S., D.P.H., Nutrition Officer to Govt. of Bihar, Public Health Laboratory, Patna-4.
- Lall, R. M., 21 "L" P. V. College Hostel, Hoshiarpur, Punjab.
- Law, Nirmal Ch., M.Sc., D.Phil., 50, Kailas Bose Street, Calcutta.
- Law, Satyachurn, M.A., B.L., Ph.D., F.Z.S., F.N.I., M.B.O.U., 50, Kailas Bose Street, Calcutta.
- Lawande, Y. V., Prof., Chemistry Dept, St. Xavier's College, Cruickshank Road, Bombay-1.
- Lele, (Mr.), Associated Instrument Manufacturers (India) Ltd., B-5, Clive Buildings, P.O. Box 2136, Calcutta-1.
- Lele, Sadashiv Shamaraao, M.Sc., Senior Research Scholar, Govt. of India, Faculty of Science, M. S. University, Baroda.
- Lele, Trimbak Purushottam, Senior Lecturer, Faculty of Education & Psychology, M. S. University, Baroda.

- Limage, S. D., Ph.D.,** Rasayana-Mandira, Kapilasharma, Navi Peth, 128, Sadshiv, Poona-2.
- Lloyd, M. E.,** Manager, Standard Vacuum Oil Co. Ltd., 6, Church Lane, Calcutta-1.
- Lohar, Jayanarayan M., M.Sc.,** Demonstrator in Chemistry, Faculty of Science, Baroda.
- Lokasangraha Works, The,** 624, Sadashiv Peth, Poona-2.
- *Loomba, Ram Murti,** Lecturer in Philosophy, Lucknow University, Lucknow.
- Luthra, Jai Chand, Rai Bahadur, I.A.S. (Retd.),** Agricultural Research Institute, New Delhi.

M

- Macmillan, (Dr.) William George,** Research Director, Indian Jute Mills Association Research Institute, 3, Taratola Road, Calcutta-27.
- Madan, Parshatam Lall, B.Sc., Eng. (Edin.), D.I.C., M.Sc.Eng. (Lond.),** Prof. of Applied Mechanics, Faculty of Technology (Ind Engineering), M. S. University of Baroda, Baroda
- Madhava, K. B., M.A., A.I.A. (Lond.), F.N.I.,** Professor, "Amrutha", 130, Lloyds Road, Cathedral P.O., Madras-6.
- Madhavi, (Miss) V. A.,** Eranampalam House, Kallat-Malabar.
- Magar, Dr.) N. G.,** Biochemistry Dept., Institute of Science, Bombay.
- Mahadevan, C., M.A., D.Sc., F.A.Sc., F.N.A.Sc., F.M.G.S., F.N.I.,** Head of the Dept. of Geology, Andhra University, Erskine College of Natural Sciences, Waltair.
- Mahabale, T. S., B.A., M.Sc., Ph.D., F.N.I., F.A.Sc., F.B.S.,** Botany Dept., Institute of Science, Bombay-1.
- *Mahalanobis, P. C., M.A., B.Sc., F.N.I., I.E.S., O.B.E., F.R.S.,** Indian Statistical Institute, 204, Barrackpore Trunk Road, Calcutta.
- Mahalanobis, S. K.,** 90, Park Street, Calcutta-16.
- Mahajan, L. D., M.Sc., Ph.D., F.Inst.P. (Lond.),** Prof. & Head of the Physics Dept., Mahendra College, Patiala (State).
- *Mahajani, A. V., M.Sc.,** Lecturer in Chemistry, University of Saugar, Saugar.
- Mahboob, (Dr. Miss) S.,** Central Drug Research Institute, Chatter Manzil Palace, Lucknow.
- Maheswari, Panchanan, D.Sc., F.N.I.,** Professor of Botany, Delhi University, Delhi.
- Manna, Gobind Kishore, M.Sc., D.Phil.,** 92/1, Kumorpara Lane, Kasba, Calcutta-31.
- Manager, M. P. Sugar Mills Co., Ltd., P.O. Majhulia, R. S. Champaran.**
- Maukam, B. N., B.Sc., Ph.D.,** Prof. of Chemistry, Vithalbhai Patel Mahavidyalaya, Vallabh Vidya Nagar, Anand.
- Mandal, S. C.,** Agric. Chemistry Section, Fruit Research Station, Sabour (Bhagalpore).
- Maiti, Ajit Kumar, 9, Kali Prasanna Banerjee Road, Calcutta-6.**
- *Maitra, B., M.Sc., F.C.S.,** Director, Calcutta Chemical Co. Ltd., 35, Pandit Road, Calcutta-29.
- *Maitra, J. N., M.Sc., M.B., D.T.M., D.P.H.,** Cardiologist, 1, Corries Church Lane, Amherst Street P.O., Calcutta
- Maitra, Susilranjan, M.Sc., D.Phil.,** Lecturer in Physiology, University College of Science, 92, Upper Circular Road, Calcutta.
- Majid, (Dr.) S. A., Khan Mirza, Mahendru P.O., Patna-6.**
- Majumdar, D. N., M.A., P.R.S., Ph.D. (Cantab.), F.R.A.I., F.N.I.,** Prof. & Head of the Dept. of Anthropology, Lucknow University, Lucknow.
- Majumdar, (Dr.) G. G., M.Sc., Ph.D.,** 187, Kasaba Peth, Poona-2.
- *Majumdar, Girija Prasanna, M.Sc., Ph.D., F.N.I.,** Biology Dept., Dacca University, Ramna, Dacca.

- Majumdar, J. N.**, M.B., L.R.C.P., M.R.C.S., etc., Medical Practitioner, 3, Chowringhee Square, Calcutta.
- Majumdar, K. K.**, M.Sc., D.Phil., A.M.Tech.I., Senior Lecturer in Mineral Dressing, Indian School of Mines and App. Geology, Dhanbad.
- Majumdar, R. C.**, Dr.Phil.Nat., Associate Prof. of Physics, Delhi University, Delhi.
- Majumder, Sanat Kumar**, Research Worker, Jute Agriculture Research Institute, Barrackpore.
- Majumdar, Vrajatal Himatlal**, Naroshihiji's Pole, near Dharm Nivas, Baroda.
- Malakar, M. C.**, Dr.Sc. (Paris), Asst. Research Officer, Indian Council of Medical Research, 92, Upper Circular Road, Calcutta-9.
- Malkani, Jethmel H.**, Senior Lecturer in Applied Mechanics, Faculty of Technology (including Engineering), M. S. University, Baroda.
- Malhotra, C. L.**, M.D., P.C.M.S., Prof. of Pharmacology, Lady Hardinge Medical College, New Delhi.
- Malhotra, D. R.**, D.Sc., M.I.Chem.E., F.I.M., M.I.E., F.N.I., Chief Metallurgist, Western Railway, Ajmer.
- Malhotra, K. L.**, Prof. & Head, Biology Dept., Panjab University (Camp) College, Market Flat No. 5, South Patel Nagar, New Delhi.
- Malurkar, S. L.**, Director, Colaba & Alibag Observatories, Bombay-5.
- Mallik, A. K.**, M.Sc., Meteorologist, Meteorological Office, Poona-5.
- Mallik, N. C.**, A.M.M.E., Foreman, Template & Jog Shop, Structural Dept., Burn & Co. Ltd., Howrah.
- Mallik, P. C.**, Fruit Research Station, Sabour (Bhagalpore).
- Mallik, Promotho Nath**, Asstt. Electrical Engineer, West Bengal Govt., 18/B, Brojonath Datta Lane, Calcutta-12.
- Mandal, Gurudas**, Research Scholar, Dept. of Applied Chemistry, University College of Science, 92, Upper Circular Road, Calcutta-9.
- Manerikar, S. D.**, 21, Pratap Ganj, Baroda.
- Mangalik, Vanmali Sharan**, M.D., D.C.P. (Lond.), Reader in Pathology, M. G. Medical College, Lucknow.
- Masani, Nariman Adarji**, M.A., B.Sc., Technical Chemist, Petit Mansions, Sleater Road, Bombay-7.
- Mansingh, Bishan**, B.A., Zaminder & Farmer, The Man Bhavan, Fatehpur, U.P.
- Marathay, S. H.**, M.B.B.S., Clinic for Contact Lenses & life like Eyes, 183, Girgaum Road, Bombay-14.
- Marathe, (Mrs.) K. V.**, Asst. Lecturer, Ismail College, Jogeshari, Bombay.
- Marathe, V. B.**, Asst. Lecturer, The Institute of Science, Mayo Road, Fort, Bombay.
- Marie, Prof. (Miss) M. Jaya**, M.A.L.T., Holy Cross College, Teppakulum P.O., Trichinopoly.
- Mathew, N. T.**, M.A., M.Sc., Chief Statistical Officer, Army Statistical Organisation, Ag's Branch, Army Head Quarter, New Delhi.
- Mathur, G. D.**, M.A., M.Sc., Statistical Research Officer, Office of the Economic Adviser, Govt. of India, New Delhi.
- Mathur, J. L.**, Works Manager, Hargolal & Sons, The Science Apparatus Workshop, Ambala Cantt.
- Mathur, (Dr.) K. N.**, D.Sc., F.Inst.P., Deputy Director, National Physical Laboratory of India, Hillside Road, New Delhi-12.
- Mathur, Raj Swarup**, M.Sc., A.Inst.P., M.A.P.S., Prof. & Head of Physics Dept., D.A.V. College, Kanpur.
- Mathur, S. M.**, M.Sc., F.G.M.S., A.M.G.I., Geological Survey of India, Ali Manzil Wala Qadar Road, Lucknow.
- Mathur, S. N.**, M.B.B.S., Ph.D., Prof. of Physiology, Medical College, Lucknow.
- Mazumder, Arabinda**, M.Sc., 171/1B, Rash Behari Avenue, Calcutta-19.

- Mazumder, K. C.**, The New Central Research Laboratory, Tata Iron & Steel Co. Ltd., P.O. Tatanagar.
- McFarland, Francis X.**, Head of the Dept. of Physics, Loyola School, Jamshedpur.
- Mehra, Bal Krishan**, M.Sc., F.A.F.P.E., Technical Representative, Chas. Pfizer & Co. Inc., New York, C/o. Dey's Medical Stores, 6/2B, Lindsay Street, Calcutta-16.
- Mehra, H. R.**, M.Sc., Ph.D., F.N.I., F.N.A.Sc., Prof. of Zoology, University of Allahabad, 33, Chatham Lines, Allahabad.
- Mehra, P. N.** D.Sc., Head of the Dept. of Botany, East Punjab University, Khalsa College, Amritsar.
- Mehra, R. K.**, M.Sc., Central College of Agriculture, Anand Parbat, Karol Bagh, New Delhi.
- Mehra, Sardari Lal**, Asst. Development Officer, Ministry of Commerce & Industry, Development Wing, New Delhi.
- Mehrotra, H. N.**, M.Sc., Asst. Technical Officer, I.C.I. Ltd., 18, Strand Road, Calcutta.
- Mehrotra, (Dr.) R. C.**, Chemistry Dept., Allahabad University, Allahabad.
- Mehta, Atul Ramakant**, Demonstrator in Botany, Faculty of Science, M. S. University, Baroda.
- Mehta, B. N.**, M.Sc., A.H.B.T.I., Public Health Chemist, Pratapganj, Baroda.
- Mehta, C. R.**, M.Sc., Ph.D., Prof. of Pharmaceutical Chemistry, L. M. College of Pharmacy, Ahmedabad-9.
- Mehta, D. R.**, D.Sc., Chief Chemist, Pharmaceutical Laboratory, Alembic Chemical Works Co. Ltd., Baroda.
- Mehta, G. K.**, B.Sc., Ph.D., A.Inst.P., Reader, Dept. of Physics, Karnatak University, Dharwar.
- *Mehta, Jivraj Narayan**, M.D., M.R.C.P., L.M. & S., F.C.P.S., Physician, Minister, Bombay State, Khamulta Hall, 16, Altamont Road, Cumballa Hill, Bombay-26.
- Mehta, M.**, Associated Instrument Manufacturers (India) Ltd., B-5, Clive Buildings, Post Box No. 2136, Calcutta.
- Mehta, (Miss) Maneck M.**, M.A., M.Sc., D.Sc., Ph.D., F.I.C., D.I.C., Young Ladies High School, Stafford House, 33, Murzban Road, Fort, Bombay.
- *Mehta, P. I.**, C/o. Minerva Dyes & Chemicals Co., Inside Khanstate Opp. Pandi Dharmashala, 262, Thakurdwar Road, Bombay-2.
- Mehta, Prayag**, Psychologist, Vocational & Educational Guidance Bureau, Ganga-shahar, Bikaner.
- Mehta, R. R.**, C/o. Technical Director, Instruments & Chemicals Ltd., Ambala Cantt.
- Mehta, S. M.**, B.A., M.Sc., A.R.I.C., Prof. of Inorganic Chemistry, The Institute of Science, Mayo Road, Bombay.
- Mehta, (Dr.) T. N.**, Prof. of Applied Chemistry, Laxminarayan Institute of Technology, Amaravati Road, Nagpur.
- Mehendaley, Vaman Ganesh**, 20, Hanbury Road, Kirkee, Poona-3.
- Mene, (Dr.) P. S.**, Director-in-charge, Laxminarayan Institute of Technology, Nagpur University, Nagpur.
- Menon, K. P.**, L.R.C.P. & S. (Edin.), 1, Viviani Road, Richards Town, Bangalore-5.
- Menon, K. K.**, Senior Research Officer, Durron of Mineral Survey of Research, Travancore, University, Trivandrum.
- Menon, P. Balarama**, Asst. Research Officer, Section of Parasitology, Indian Veterinary Research Institute, Izatnagar.
- Menon, T. K. N.**, B.A.T.D., M.A. (Edin.), Principal, Secondary Teachers Training College, Editor, Journal of Education & Psychology, Sayajiganj, Baroda.

- *Metre, W. B.**, Representative of Burmah Oil Co., (Benefactor), Geologist, B.O.C. (I.C.) Ltd., Digboi P.O., Assam.
- Merh, Sukumar S.**, 17, Adhyapak Kutir Camp, Baroda.
- Minakshinsundaram, S.**, Professor, Andhra University, Waltair.
- Mirchandani, T. J.**, M.Sc., A.I.I.Sc., Ph.D., Head of the Division of Agronomy, Indian Agriculture Research Institute, New Delhi.
- Misra, (Dr.) B. D.**, M.S., 989, Aryanagar, Lucknow.
- Misra, G.**, M.Sc., Lecturer in Botany, Ravenshaw College, Cuttack-3.
- Misra, M. L.**, M.A., D.Sc., Head of the Mathematics Dept., University of Saugor, Saugor
- Misra, Prakash Narayan, M.A.**, Lecturer in English, Agra University, D. A. V. College, Dehra Dun.
- Misra, R. A. P.**, Indian Wild Barfield Co. Ltd., Fort Chambers, 6/10, Dean Lane, Hammam Street, Fort, Bombay
- Misra, R. C.**, M.Sc., Ph.D., F.G.M.S., M.M.G.I., Reader in Geology, Lucknow University, Lucknow.
- *Misra, (Dr.) Ramadhar, M.A., Ph.D.**, Reader in Mathematics, University of Lucknow, Lucknow
- *Misra, (Dr.) Ramadeo, M.Sc., Ph.D.**, Reader and Head of the Botany Dept., University of Saugar, Saugar, C.P.
- Misra, (Miss) Rani, M.Sc.**, Lecturer in Chemistry, C/o. Mr P. C. Misra, Advocate, Dyapurgola, Patna
- Misra, S. D.**, (Prof.), C/o Mr R. C. Rai, M.A., Manjidana Colony, Bornala P.O., Nagpur
- Misra, (Prof.) Sukdeb Prasad, G. M. College, Sambalpur**
- Mishra, D.**, M.Sc., Lecturer in Chemistry, G. M. College, Sambalpur, Orissa.
- Mishra, (Prof.) Ram Chandra**, Dept. of Geology, Patna Science College, Patna.
- Mistry, (Mrs.) Coom S.**, 84, Sion Road, Sion, Bombay-22.
- Mistry, (Miss) Dilnavaz S.**, 84, Sion Road, Sion, Bombay-22.
- Mistry, S. M.**, M.Sc., A.I.I.Sc., 84, Sion Road, Bombay-22.
- Mitra, A. C.**, Mg. Director, Messrs International Tyres & Motors Ltd., 2, Rowland Road, Calcutta
- *Mitra, (Miss) Abha, M.A., B.L.**, Prof. of Mathematics, Patna Women's College, Patna.
- Mitra, (Prof.) B. K.**, F.Z.S., Benoy Bose Road, Calcutta-25.
- Mitra, B. N.**, Manager, Agriculture Machinery Mnfg. Corp'n. Ltd., 38/1, Bose Para Lane, Baghbazar, Calcutta.
- Mitra, C. R.**, Agriculture Machinery Manufacturing Corp'n. Ltd., 38/1, Bose Para Lane, Baghbazar, Calcutta
- Mitra, Debendra Nath, M.A., D.Phil.**, Lecturer, Indian Institute of Technology, Kharagpur.
- Mitra, (Miss) Eva, M.A.**, Research Asst (Section Grade), 14, Chowringhee Terrace, Calcutta-20.
- Mitra, G. B.**, M.Sc., Lecturer, Dept. of Physics, Indian Institute of Technology, Kharagpur.
- Mitter, G. C.**, O.B.E., M.Sc., F.R.I.C., F.N.I., Chief Technical Adviser (Mints), Bombay.
- Mitra H. K.**, M.Sc., Ph.D., M.I.Cer.E., F.N.I., Tata Iron & Steel Co., Ltd., 12-A, Road East, Jamshedpur.
- Mitra, J. K.**, B.Sc., B.L., 25/1, Chandra Chatterji Street, Bhowanipur, Calcutta-25.
- Mitra, Kalidas, M.B.B.S., D.P.H., D.T.M. & H., F.N.I., F.S.S.**, Directorate General of Health Services, New Delhi.
- Mitra, Mrityunjoy Kumar, Chemist, Group Laboratory, Jardine Henderson Ltd., 56/1B, Sree Gopal Mullick Lane, Calcutta-12.**

- Mitra, (Mrs.) P.**, Director, Faraday Corporation Ltd., 309, Bowbazar Street, Calcutta-12.
- Mitra, (Capt.) R. D.**, 91, Field Ambulance, C/o. New Delhi 56 A.P.O.
- Mitra, Ramprasad**, D.Sc., Dept. of Chemistry, Delhi University, Delhi.
- Mitra, S. B.**, Director, Faraday Corporation Ltd., 309, Bowbazar Street, Calcutta-12.
- Mitra, S. K.**, M.Sc., Analytical & Consulting Chemist, 3/1, Bankshall Street, Calcutta.
- Mitra, S. K.**, Managing Director, S. K. Mitra & Co. Ltd., 5, Manmatha Bhatta-charjee Street, Calcutta-4.
- ***Mitra, S. K.**, D.Sc., F.N.I., Sir Rashbehary Ghose Professor of Physics, Head of the Dept. of Radio Physics & Electronics, University College of Science, 92, Upper Circular Road, Calcutta-9.
- Mitra, S. K.**, A.M.Ch.E., M.A.E., M.I.I.Chem.E., Suite 8, 26, Chowringhee, Calcutta-13.
- Mitra, S. P.**, M.Sc., D.Phil., F.N.A.Sc., Lecturer in Chemistry, Sheila Dhar Institute of Soil Science, University of Allahabad, Allahabad.
- Mitra, S. R.**, Agriculture Machinery Manufacturing Corpn. Ltd., 38/1, Bose Para Lane, Baghbazar, Calcutta.
- Mitra, Subodh**, M.B., M.D., F.R.C.S.Ed., F.R.C.O.G., F.A.Sc., F.N.I., Director, Cittaranjan Cancer Institute, Prof of Midwifery & Gynaecology, R. G. Kar Medical College Hospital, 4, Chowringhee Terrace, Calcutta-20.
- ***Mitra, (Mrs.) Suborna**, M.B.B.S., D.P.H., D.M.C.W., 25/1, Chandra Nath Chatterjee Street, Calcutta-25.
- Mitra, Suhrit Chandra**, M.A., F.N.I., Head of the Psychology Dept., University College of Science, 92, Upper Circular Road, Calcutta.
- Mitter, P. C.**, M.A., Ph.D., F.N.I., Palit Professor & Head of the Dept. of Pure Chemistry, Calcutta University, University College of Science, 92, Upper Circular Road, Calcutta.
- Mitter, Ranjit Coomar**, Councillor, Calcutta Corporation, 5C, Ramkrishna Lane, Calcutta-3.
- Modak, N. V.**, B.E., M.I.C.F., M.I.E., M.I.M. & Cy.E., F.R.San.I., Ac., J.P., City Engineer, Bombay Municipality, 'Udayan', Shivaji Park, Bombay-28.
- Modi, D. F.**, B.Sc., Head of the Electrical Dept., C/o. William Jacks & Co., Ltd., 16, Clive Street, Calcutta.
- Mody, G. S.**, M.B.B.S., Anatomist, Dept. of Anthropology, Indian Museum, 27, Chowringhee, Calcutta-13.
- Moghe, M. A.**, M.A., M.Sc., Ph.D., Birla College, Pelani, Rajasthan.
- Mohajir, (Miss) Akhtar**, M.Sc., Central Laboratories for Scientific & Industrial Research, Jama' Osmania, Hyderabad-Deccan.
- Mohan, Brij**, Ph.D., Prof. of Mathematics, Banaras Hindu University, Banaras.
- Mohanti, P. C.**, D.Sc., F.N.I., F.Inst.P., M.A.I.E.E., Sir Rash Behari Ghose Professor & Head of the Dept. of Applied Physics, University College of Science & Technology, 92, Upper Circular Road, Calcutta.
- Mohanty, R.**, M.Sc., Ph.D., Professor & Head of the Dept. of Mathematics, Ravenshaw College, Cuttack-3.
- Mohapatra, Sankarsan**, Lecturer in Mathematics, Ravenshaw College, Cuttack-3.
- Mohsin, (Dr.) S. M.**, Lecturer in Zoology, College of Science, Osmania University, Hyderabad-Dn.
- Mohury, B. D.**, 66A, Rasthrapathi Road, Post Box No. 68, Secundarabad.
- Monga, I. P. S.**, Lecturer, Anthropology Dept., University of Delhi, Delhi-9.
- ***Mookerjee, Himadri Kumar**, M.Sc., D.I.C., D.Sc., F.N.I., Sir Nilratan Sircar Professor & Head of the Dept. of Zoology, Calcutta University, 27, Kailas Bose Street, Calcutta.
- Mookerjee, K. C.**, M.Sc., Psychologist, Inter-Provincial Mental Hospital, Kanka P.O., Ranchi.

- Mookherji**, Piyushansu Sekhar, M.Sc., Lecturer in Zoology, Surendra Nath College, 24, Harrison Road, Calcutta-9.
- Mookerjee**, R. P., M.A., B.L., 77, Ashutosh Mukherjee Road, Bhowanipore, Calcutta.
- Mookerjee**, Sivatosh, M.Sc., Ph.D., Prof. & Head of the Dept. of Zoology, Presidency College, Calcutta.
- Mukherjee**, A. N., Major, M.Sc., M.B., Superintendent, Mental Hospital, Baroda.
- Mukherjee**, Achintya Kumar, M.Sc., M.B.B.S., Lecturer in Physiology, Presidency College, Calcutta-12.
- Mukherjee**, Ajit Kumar, Inorganic Chemistry Laboratory, Indian Association for the Cultivation of Science, Calcutta-32.
- Mukherjee**, Asoke Kumar, M.Sc., Physical Chemistry Laboratory, College of Engineering & Technology, Calcutta-32.
- Mukherjee**, B. K., M.Sc., B.L., Asst. Superintendent, H.E.H. the Nizam's Geological Survey, Jeera Compound, Secundarabad-Dn.
- Mukherjee**, Bankim Chandra, M.Sc., F.G.S., A.M.Inst., F.G.M.S., Lecturer in Applied Geology, College of Engineering & Technology, Calcutta-32.
- Mukherjee**, J. N., C.B.E., D.Sc. (Lond.), F.C.S., F.N.I., F.R.A.S.B., 10, Puran Chand Nahar Avenue, Calcutta-13.
- Mukherjee**, Jagadananda, M.Sc., Senior Research Scholar, Govt. of India, Dept. of Physiology, University College of Science, 92, Upper Circular Road, Calcutta.
- Mukherjee**, K. C., M.A., P.R.S., F.N.I., Lecturer in Psychology, University College of Science, 92, Upper Circular Road, Calcutta.
- Mukherjee**, (Dr.) K. L., Dept. of Pharmacology, School of Tropical Medicine, Calcutta.
- Mukherjee**, Kashinath, Lecturer, City College, 25/B, Nepal Bhattacharya 1st Lane, Calcutta-26.
- Mukherjee**, M. K., M.Sc., Ph.D., 44, Maniktala Main Road, Calcutta-11.
- Mukherjee**, Paresh Nath, Lecturer in History, D. A. V. College, 2, Vishnu Road, Delhra Dun.
- Mukherjee**, S., M.Sc., Ph.D., A.R.I.C., A.I.I.Sc., Asst. Prof. of Sugar Chemistry, Indian Institute of Sugar Technology, Kanpur.
- Mukherjee**, S. K., M.Sc., General Manager, Instrument Research Laboratory Ltd., 309, Bowbazar Street, Calcutta-12.
- Mukherjee**, S. K., M.Sc., Lecturer in Biology, Surendra Nath College, Calcutta-9.
- Mukherjee**, (Prof.) S. M., Prof. of Chemistry, Punjab University, Hoshiarpur, E. Punjab.
- Mukherjee**, S. N., M.Sc., Prof. of Physical Chemistry, College of Engineering & Technology, P.O. Jadavpur College, Calcutta-32.
- Mukherjee**, S. N., Sectional Officer, C. P. W. D., 142/C, Russa Road, Calcutta-26.
- Mukherjee**, S. S., District Engineer, B. N. Rly., B. N. Rly. House, Kidderpore, Calcutta.
- Mukherjee**, Sailendu Sekhar, Lecturer, Dept. of Biochemistry, Nagpur University, Nagpur.
- Mukherjee**, Sudhamoy, M.Sc., Quinologist, P.O., Mungsoo, Dt. Darjeeling.
- Mukherjee**, Sunil Kumar, M.Sc., D.Sc., Horticulturist, Govt. of West Bengal, Krishnagar, Nadia.
- Mukherjee**, Umadas, M.Sc., Prof. & Head of the Dept. of Physics, College of Science, Nagpur.
- Mukherji**, Amal Kumar, M.A., B.Sc., B.Com., 12, Mission Row, Calcutta.
- Mukherji**, Asrujit, B.E.E., Mechanical Engineer, Mor Project, 16, Sardar Sankar Road, Calcutta-26.
- ***Mukerji**, B., D.Sc., F.A.Ph.S., F.N.I., Director, Central Drug Research Institute, Chatter Manzil Palace, Lucknow.

- Mukherjee, Basanta K.**, M.Sc., A.R.T.C., D.I.C., Lecturer, Applied Chemistry Department, University College of Science, 92, Upper Circular Road, Calcutta.
- Mukerji, Bimal**, "Babui-Basha", 57, Ballygunge Gardens, Calcutta-19.
- Mukherji, D. K.**, Asst. Economic Botanist to the Govt. of West Bengal, Agricultural Research Institute, 60, Asoka Park, Tollygunge, Calcutta.
- Mukerji, Durgadas**, M.Sc., Zoological Laboratory, University College of Science, 35, Ballygunge Circular Road, Calcutta.
- Mukerji, (Dr.) H. N.**, M.Sc., Ph.D., D.I.C., Agricultural Chemist to the Government of Bihar, P.O. Sabour, Dist. Bhagalpore
- Mukherji, (Mrs.) Krishna**, M.Sc., M.H., Research Asst., Mycology Dept., State Agricultural Research Institute, 230, Netaji Subhas Road, Calcutta-40.
- Mukerji, Mohi Mohan**, M.S., A.M.E.E., A.M.I.E., M.I.R.E., A.M.A.I.E.E.; Asst. Professor of Electrical Engineering, College of Engineering & Technology, Calcutta-32.
- Mukerji, (Dr.) Nirod**, Reader in Education, Gauhati University, Gauhati, Assam.
- Mukharji, Pratul Ch.**, D.Sc., Research Associate, Columbia University, N.Y., U.S.A., Plot 159, Block 'G', New Alipore, Calcutta-33.
- ***Mukherji, R. G.**, M.Sc., Mem.A.I.E.E. (New York), M.I.E.E., A.M.I.E., Electrical Executive Engineer, Northern Electrical Division, West Bengal, New Block, Writers Building, Calcutta-1.
- Mukerji, (Mrs.) Rani**, M.Sc., C/o. A. K. Mukerji, 12, Mission Row, Calcutta.
- Mukerji, S. N.**, M.Sc., D.I.I.Sc., A.M.I.E., Chartered Engineer, Dy. Director, (Physical) Govt. Test House, Alipore, Calcutta-27.
- Mukherji, Sudhir Kumar**, C/o. Indian Psychotherapeutical Society, P-23, Improvement Trust Road, Calcutta-14.
- Mulay, B. N.**, M.Sc., Ph.D., F.B.S., Head of the Dept. of Botany, C/o. Birla College, Pelani.
- Mulye, Bhalchandra D.**, M.B.B.S., Sakkar Bazar, Indore City.
- Mullick, D. N.**, Ph.D., Animal Nutrition Section, Indian Veterinary Research Institute, Izatnagar, Bareilly, U.P.
- Munigaviappa, M.**, Research Fellow, Dept. of Mathematics, Central College, Bangalore.
- Munshi, D. M.**, M.Sc., Prof. of Zoology, St. Xaviers College, Cruickshank Road, Bombay-1.
- Munshi, Nihar Kumar**, M.B., D.O.M.S., 55, Creek Road, Calcutta-14.
- Munshi, S. K.**, Managing Director, Olimpia Rubber Works, P-35, Princep Street, Calcutta-13.
- Murty, D. S. R.**, Physical Laboratories, Osmania University, Hyderabad-7.
- Murty, K. N.**, Central Laboratories for Scientific & Industrial Research, Hyderabad-Dn.
- Murty, K. S.**, M.Sc., Research School, Central Laboratories, Jamai-Osmania, Hyderabad-Dn.
- Murty, V. N.**, M.Sc., Ph.D., Division of Animal Nutrition, Indian Veterinary Research Institute, Izatnagar.
- Murthy, K. Krishna**, B.Sc., D.T.T., Senior Lecturer in Textile Technology, Faculty of Technology, M. S. University of Baroda, Baroda.
- Murthy, L. S. Krishna**, B.Sc., F.A.Sc., F.G.S., F.G.M.S., Khairatabad, Superintending Geologist, Hyderabad Geological Survey, 3, Jeera, Secunderabad-Dn.
- Muthana, (Dr.) M. S.**, Applied Chemistry Dept., Indian Institute of Technology, Kharagpur.
- Muthuswami, T. N.**, Prof. of Geology, Annamalai University, Annamalainagar.
- Muttoo, Pandit R. N.**, B.Sc., LL.B., 'Madhuban', Ramgarh P.O., Nainital Dt.
- Mysore Sugar Company Ltd.**, The Secretary, Sri Jayachamaraja Wadayan Road, Post Box No. 64, Bangalore-2.

N

- Nabar**, G. M., M.Sc. Tech., Ph.D., B.A., M.Sc., Dept. of Chemical Technology, University of Bombay, Bombay-19.
- Nabar**, J. A., M.Sc., LL.B., Prof. of Chemistry, Wilson College, Bombay-7.
- Nag**, M. K., M.Sc., Deptt. of Anthropology, Statistical Section, Govt. of India, Indian Museum, Calcutta
- Nag**, Tara Das, Scientific Photographer, Jute Agricultural Research, 50/1, Densanagazi Road, Pathakpara, Bally, Howrah.
- Nagabhusanam**, K., Prof. of Statistics, Andhra University, Waltair.
- Nagappa**, Y., M.Sc., C/o. The Assam Oil Co., Ltd, P.O. Digboi, Upper Assam.
- Naidu**, Bhoj Raj, Central Laboratories for Scientific & Industrial Research, Hyderabad-Dn.
- Naik**, Gunvantrao Nichhabhai, Chemistry Dept., Faculty of Science, M. S. University, Baroda.
- Naik**, (Dr.) K. G., Pratap Ganj, Baroda-2
- Naik**, S., M.Sc., Lecturer in Botany, G. M. College, Utkal University, Sambalpur.
- Naik**, (Dr.) S. K., Veterinary Asstt. Surgeon, Shajapur, M.B.
- Naik**, Y. G., M.Sc., Ph.D., Prof. of Physics, Gujrat College, Ahmedabad.
- Nair**, K. R., Ph.D., D.Sc. (Lond.), Statistician, Forest Research Institute, Dehra Dun.
- Namjoshi**, (Prof.) A. N., M.Sc., R. A. Podar Medical College, Warli, Bombay-18.
- Nanjundayya**, C., M.Sc., Ph.D., F.T.L., Director, Technological Laboratory, Matunga, Bombay-19.
- Nandi**, Hari Kinkar, M.Sc., Lecturer, Dept. of Statistics, University of Calcutta, Ashutosh Building, Calcutta
- Nandi**, (Mrs.) Kanak, Post Graduate Dept. (Physiology), Calcutta University, 16, Narendra Sen Square, Calcutta-9.
- Nandi**, (Dr.) P. N., M.Sc., Ph.D., D.I.C., Section of Microbiology, Bose Research Institute, 93, Upper Circular Road, Calcutta.
- Nandy**, Sukumar, Moghalpara Lane, Post & Vill. Hooghly, W. Bengal.
- Nanda**, Madan Mohan, Lecturer in Mathematics, Ravenshaw College, Cuttack-3.
- Nanda**, Sachchida, M.A., F.R.A.I., Head, Anthropology Dept., Bihar University, Ranchi.
- Narasimhan**, A. S., B.Sc., 12, Soundara Rajan Street, Madras-17.
- Narayan**, B. T., M.A., Ph.D., Deputy Director of Agriculture, Dept. of Agriculture (Govt. of Mysore), Seshadri Road, Bangalore.
- Narayana**, Basudeva, M.Sc., M.B., Ph.D., F.R.S.E., Vice-Chancellor, Patna University, Patna.
- Narayan**, Dharam, M.S., Professor of Anatomy, K. G. Medical College, Lucknow.
- Narayanan**, E. S., M.A., Ph.D., D.I.C., F.R.E.S., F.E.S.I., Head of the Division of Entomology, Indian Agriculture Research Institute, New Delhi.
- Narayana**, (Dr.) N., Agricultural Chemist to the Govt., Bombay State, Poona-5.
- Narayana**, (Dr.) R. Satya, Prof. of Physics, Dept. of Physics, Osmania University, Hyderabad-Dn.
- Narain**, (Dr.) Raj, University Reader, Babuganj, Lucknow.
- Narlikar**, V. V., B.Sc., B.A., F.R.A.S., F.N.I., Head of the Mathematics Dept., Banaras Hindu University, Banaras.
- Nasrulla**, K., Head of the Dept. of Botany, Nizam College, Hyderabad-Dn.
- Natarajan**, C. V., B.Sc., M.B. & B.S., Dr.P.H., Deputy Director, Public Health, Bangalore.
- Navalkar**, (Dr.) B. S., Biology Dept., M. N. College, Visnagar, N. Gujrat.
- Nath**, M. C., D.Sc., F.N.I., F.I.C., Chitnavis Professor & Head of the University Dept. of Biochemistry, Nagpur.

- Nath, (Mrs.) M. C.,** C/o. Prof. M. C. Nath, The Terraces, Amravati Road, Nagpur.
- Nath, Ram, M.Sc.,** In-charge, Regional Soil Laboratory, 4, Cantonment, Banaras.
- Nayar, M. Raman,** Reader in Chemistry, Lucknow University, Lucknow.
- Nayudamma, (Dr.) Y.,** Assistant Director, Central Leather Research Institute, Madras-20.
- Nene, (Prof.) V. P.,** Pratap College, Amalner.
- Neogi, Hirendra Nath, M.Sc.,** 13/1, Nather Bagan Street, Calcutta-5.
- Nigam, (Mrs.) Raj Kishore,** Old Nizarabad Road, Lucknow, U.P.
- Nizam Sugar Factory Ltd.,** Shakarnagar, Via Nizamabad, Hyderabad-State, Deccan.
- Nirula, Kanwal K., M.Sc.,** Assoc.I.A.R.I., Entomologist, Central Coconut Research Station, Kayangulum, Travancore.
- Nirula, R. L., B.Sc., Ph.D., D.I.C.,** Principal, Vidarbha Maha Vidyalaya, Amaravati, M. P.
- Niyogi, Dipankar,** Lecturer in Geology, Indian Institute of Technology, Kharagpur.
- Niyogi, N. C.,** Lecturer, Bengal Engineering College, Post Botanic Garden, Howrah.
- North Bengal Sugar Mills Co. Ltd.,** The, 8, Dalhousie Sq., Calcutta.

O

- Ojha, Jagadish Chandra, M.A.,** 136-B, Rash Behari Avenue, Calcutta-29.
- Oza, Kantilal Damodardas, Sr.** Lecturer in Mech. Eng., M. S. University of Baroda, Suratwala Building, Baroda.
- Oza, (Dr.) T. M.,** Associate Prof. of Inorganic Chemistry, Institute of Science, Mayo Road, Fort, Bombay.
- *Olpadvala, E. S.,** 52, Chowringhee Road, Calcutta.
- Osmani, (Miss) Razia,** Central Laboratories for Scientific & Industrial Research, Jamai Osmania P.O., Hyderabad-Dn

P

- Padate, Satyendra Narayanrao,** Dept of Botany, Faculty of Science, M. S. University, Baroda.
- Padmanabhan, S. Y.,** Mycologist, C. R. R. Institute, P.O. Nayayazar, Cuttack.
- Padhi, B., M.Sc., Ph.D.,** Lecturer in Botany, Ravenshaw College, Cuttack.
- Pal, B. P., M.Sc., Ph.D., F.L.S., F.B.S., F.N.I.,** Director, Indian Agricultural Research Institute, New Delhi-12.
- Pal, Nil Krishna,** Examiner of Stores, Directorate of Inspection, S. & D. Dept., 1, Ganesh Chandra Avenue, Calcutta.
- Pal, Prabhat Ranjan,** Research Scholar, Dept. of Applied Chemistry, University College of Science, 92, Upper Circular Road, Calcutta.
- Pal, R. K., D.Sc., M.R.C.P., M.Sc., M.B.,** 5/4, Ballygunge Place, Calcutta.
- *Pal, Srikantha Bhushan,** 279B, Vivekananda Road, Calcutta-6.
- Palit, Prabash Chandra,** Lecturer in Mathematics, V. D. College, Jayapore, Koraput, 'Purbasilpa', Maria Bazar, Cuttack-1.
- Panchalal, Mohanlal R.,** Junior Lecturer in Electrical Engineering, Dept. of Electrical Engineering, Faculty of Technology, M. S. University, Baroda.
- Panchang, G. M., B.A., M.Sc.,** Central Water Power Research Station, Post Box No. 18, Poona-1.
- Pande, C. S., M.Sc., Ph.D.,** Lecturer in Chemistry, The University, Lucknow.
- Pande, P. G., M.Sc., M.R.C.V.S.,** Principal, U. P. College of Veterinary Science & Animal Husbandry, Mathura, U. P.
- Pande, S. K., D.Sc.,** Reader in Botany, The University, Lucknow.

- Pandey**, Lt. S. D., Secretary, Birla Educational Trust, Pilani, Rajasthan.
- Pandya**, A. V., Director, Institute of Archaeology, Vallabh Vidyanagar, Kaira Dt., Bombay State.
- Pandya**, N. S., Lecturer in Physics, Faculty of Science, S. J. Science Institute, M. S. University, Baroda.
- Pandit**, (Dr.) C. G., M.B.B.S., Ph.D., F.N.I., D.P.H., D.I.M., Secretary, Indian Council of Medical Research, Post Box No. 494, 'P' Block, Raisina Road, New Delhi.
- Panja**, D., M.B., F.R.S. (F.M. & H.), F.D.S. (Lond.), Formerly Head of the Department of Dermatology, School of Tropical Medicine, 250, Chittaranjan Avenue, Calcutta-6.
- Panja**, G., M.B., D.B., F.N.I., Prof. of Bacteriology & Pathology, Calcutta School of Tropical Medicine, 117, Vivekananda Road, Calcutta-6.
- ***Panikkar**, N. Kesava, M.A., D.Sc., Chief Research Officer, Central Marine Fisheries Research Station, Madandapam Camp P.O., S. I.
- Panikkar**, S. D., M.Sc., C/o. M/s. Mehta Bros. & Chemical Works, G. T. Road, Chheharta, Amritsar.
- Panse**, V. G., Ph.D., F.N.I., Statistical Adviser, Indian Council of Agricultural Research, Jamnagar House, New Delhi
- ***Pasricha**, B. R., M.Sc., Lecturer in Mathematics, Armed Forces Academy, P.O. Inter-Service Wing, Dehra Dun, U. P.
- Paria**, Gunadhar, Dept. of Mathematics, Indian Institute of Technology, Kharagpore.
- Paranjpe**, Gopal Ramchandra, I.E.S., F.N.I., O.B.E., 'Sudarshan', 202/1, Sadashiv Road, Poona-2
- Paranjpe**, M. K., Ph.D., Prof. of Physics, S. P. College, Poona-2.
- Paranjpe**, (Miss) Maina, M., M.Sc., Ph.D., D.I.C., Asst Lecturer, Institute of Science, Mayo Road, Bombay-1
- Parija**, Prankrishna, O.B.E., M.A., B.Sc., F.N.I., I.E.S., D.Sc., 10, Cantonment Road, Cuttack.
- Parikh**, G. M., C/o. The Zandu Pharmaceutical Works Ltd., Gokhah Road (South), Bombay-14.
- Parikh**, Jagdish Manilal, M.Sc., Mehta Pole, Baroda
- Parikh**, Narendralal Krishnalal, Junior Lecturer in Chemistry, Faculty of Technology (including Engg.), M. S. University of Baroda, Baroda.
- Parikh**, R. C., 65, Mahurshi Aruvinda Hall, Baroda-2
- ***Parker**, R. N., F.C.H., C/o. Thos. Cook & Sons, Cape Town, S. Africa.
- Parikh**, Shashikant Narayandas, Org. Research Laboratory, Faculty of Science, M. S. University, Baroda.
- Parkhi**, (Miss) Sindhu Raghurat, Chemistry Dept., Faculty of Science, M. S. University, Baroda.
- Pareek**, Udai, M.A., Cert. P.S.Y. (Rome), B.T., Research Scholar, Central Institute of Education, 33, Probyn Road, Delhi-8.
- Parthasarathy**, N., B.A., B.Sc., Ph.P., F.N.I., Director, Central Rice Research Institute, Cuttack-4.
- Prarthasarathy**, S. V., Sugarcane Specialist, Sugar Cane Research Station, Gudiyattam, Madras State.
- Pant**, D. D., M.Sc., D.Litt., Lecturer in Botany, The University, Allahabad.
- Patadia**, Chunilal Dayabhai, M.B.B.S., Dr. C. D. Patadia, Alembic Colony, Baroda.
- Patel**, B. V., B.Sc., B.Pharm. (Lond.), Ph.C., B.M.S., Drugs Controller for the State of Bombay, Manekji Wadia Building, 127, Mahatma Gandhi Road, Bombay-1.
- Patel**, Bhailalbhai D., Chemist (Pharmacy), Sadar Bazar, Fatehganj Camp, Baroda.
- Patel**, Chaturbhai Shankarbhai, B.A., M.Sc., Ph.D., Pro. Vice-Chancellor, M. S. University, Baroda.

- Patel, (Dr.) Chunibhai B.**, Asst. Director of Industries (Bombay State), Kothi, Baroda.
- Patel, Dayaram K.**, Soil Physicist, Sugarcane Research Station, Padegaon, P.O. Nira R. S., Poona.
- Patel, G. J.**, B.Sc., M.S., Ph.D., Cytogeneticist, Jute Agriculture Research Institute, Barrackpore, 24-Parganas.
- Patel, J. S.**, M.Sc., Ph.D., F.I.A.Sc., Director of Agriculture, Bihar.
- Patel, Jayant G.**, Chemist (Pharmacy), B-32, Alembic Colony, Chemical Industries P.O., Baroda-3.
- Patel, Kantilal Hirabhai**, Reader & Head of Textile Engineering Dept., Faculty of Technology, Baroda.
- Patel, M. S.**, M.Sc., Lecturer in Statistics, Faculty of Science, Baroda, M. S. University, Baroda.
- Patel, (Dr.) M. S.**, Ph.D., Consulting Chemical Engineer & Economic Geologist, Santa Cruz, Bombay-23.
- Patel, P. C.**, M.B.B.S., Prof. of Anatomy, Medical College, Jaipur.
- Patel, Punjabhai M.**, Chemist, Opp. Mirsaheb's Wada, Raopura, Baroda.
- Patel, Ramanbai Dayabhai**, Chemistry Dept., V. P. College, Vallabh Vidyanagar, Via Anand, Bombay
- Patel, Ramanlal**, Sonawalla Bldg, No. 8, D-16, Tardeo, Bombay.
- Patel, Ratilal P.**, M.Sc., Ph.D., Principal, L. M. College of Pharmacy, Navarangpura Ellis Bridge, Ahmedabad-9.
- Pathak, J. D.**, Prof. of Physiology, Medical College, Baroda.
- Pathak, S. K.**, P22, Vallabh Vidyanagar, Via Anand.
- Pathak, S. P.**, M.Sc., Ph.D., Reader of Industrial Chemistry, College of Technology, Hindu University, Banaras-5.
- Pati, Tribikram**, M.A., D.Phil., 121, G. N. Jha Hostel, Allahabad University, Allahabad.
- Patil, (Dr.) B. S.**, Spectroscopic Laboratories, The Institute of Science, Mayo Road, Fort, Bombay.
- Patil, K. Z.**, Applied Chemistry Deptt., Indian Institute of Technology, Kharagpur.
- Patnaik, H.**, M.Sc., Lecturer of Botany, Ravenshaw College, Cuttack-3.
- Patwardhan, K. A.**, Daly College, Indore.
- Patwardhan, N. K.**, M.Sc., Ph.D., A.R.I.C., Asst Director, Central Building Research Institute, Roorkee
- Patwardhan, V. N.**, Director, Nutrition Research Laboratories, Indian Research Fund Association, Coonoor
- Patwardhan, Vinayak Anant**, M.Sc., Ph.D., Ferguson College, Poona-4.
- Peter, C. T.**, B.Sc., G.M.V.C., B.V.Sc., Asst Research Officer, Indian Veterinary Research Institute, Izatnagar, Bareilly.
- Peters, B.**, Prof. of Physics, Tata Institute of Fundamental Research, Apollo Pier Road, Bombay-1.
- Pethe, Govind Vishnu**, Demonstrator, Physics Dept., Faculty of Science, M. S. University, Baroda.
- Phadve, S. P.**, Bacteriology Section, Bombay Veterinary College, Parel, Bombay-12.
- Phatak, A. G.**, Demonstrator in Statistics, M. S. University, Baroda.
- Phatak, (Mrs.) Pramila T.**, Opp. Babajipura Police Gate, Market Road, Baroda.
- Phatak, V. S.**, D.Sc., Head of the Dept. of Botany, M. S. University, Baroda.
- Pichamuthu, S.**, B.Sc., Ph.D., F.R.S.E., F.G.S., F.A.Sc., F.N.I., Director of Geology, Mysore Geological Dept., Bangalore-1.
- Pillay, T. V. R.**, B.Sc., Asst. Research Officer, All India Institute of Hygiene & Public Health, 110, Chittaranjan Avenue, Calcutta.
- Pingale, S. V.**, B.Sc., Senior Scientific Officer, Central Food Technological Research Institute, Mysore.

Pittie, Madanlal, 14A, Bomanji Petit Road, Bombay-26.

Prabhu, Pandhari Nath, Ph.D., LL.B., F.A. Psy, Tata Institute of Social Science, Andheri, Bombay.

Prabhu, S. S., Research Officer, Indian Veterinary Research Institute, Izatnagar, Bareilly.

Pradhan, Dr. S., M.Sc., Ph.D., D.Sc., F.R.E.S., Inset Ecologist, Division of Entomology, Indian Agricultural Research Institute, New Delhi.

Prabhu, N. V., M.A., Reader & Head of the Dept. of Statistics, Karnatak University, Dharwar

Prakash, Om, Oil Export to U. P. Govt., H. B. Technological Institute, Kanpur.

Prakash, Prem, M.Sc., National Physical Laboratories, Hill Side Road, New Delhi.

Prakash, Satya, D.Sc., Secretary, Scientific Research Committee, U. P., Beli Avenue, Allahabad.

Prakash, Ravi, M.Sc., Research Scholar, Botany Dept., University of Allahabad, Allahabad.

Prakash, Ved, M.Sc., General Manager, Hargolal & Sons, Hargolal Road, Ambala Cantt.

Pramanik, S. K., M.Sc., Ph.D., D.I.C., Dy. Director of Observatories, Meteorological Office, Poona-5.

Pranavananda, (Rev.) Swami, of the Holy Kailas and Manosarovar, C/o Dr. S. P. Chatterjee, Head of the Dept. of Geography, Calcutta University, Calcutta

Prasad, B. N., D.Sc., Ph.D., M.Sc., F.N.I., 'Lakshmi Niwas', George Town, Allahabad

Prasad, B. N., F.R.S.E., Ph.D., M.Sc., M.B., D.T.M., Prof. of Pharmacology, P. W. Medical College, Bankpore, Abul Aas Lane, Patna

Prasad, Balbhadra, D.Sc., D.P.I., Orissa, Cuttack

Prasad, K. Narayan, B.Sc., Geological Asst., Palaeontological Sect., Geological Survey of India, 27, Chowringhee, Calcutta-13

Prasad, Kali, Prof. & Head of the Dept. of Philosophy & Education, Dept. of Philosophy, The University, Lucknow

Prasad, Mata, D.Sc., F.N.I., Director, Central Salt Research Institute, Bhavnagar.

Prasad, (Shri) Sital, M.Sc., Principal, D. A. V. College, Muzaffar Nagar.

Prasad, Seo Nandan, Sub-Divisional Officer, Public Works Dept., Gulzarbagh P.O., Patna

Prasada, R., Mycology Divn., Pusa Institute, New Delhi-12.

Premvati, (Dr.) Mrs., Zoology Dept., Lucknow University, Lucknow.

Principal, Agricultural Institute, Allahabad

Principal, G. R. Medical College, 10, J. A. Hospital, Gwalior.

Principal, Jaswant College, Jodhpur

Pruthi, (Dr.) H. S., 5, Asoka Road, New Delhi.

Purkaystha, S., B.Sc., A.T.S.M., 65A, Satis Mukherjee Road, Calcutta-26.

Puntambekar, S. V., M.Sc., Ph.D., Senior Research Chemist, Forest Research Institute, Dehra Dun, U. P.

***Punwani**, D. M., B.Sc., F.Z.S., Asst. Fisheries Training Superintendent, Central Marine Fisheries Research Station, Sassoon Dock, Colaba, Bombay.

Puranik, G. V., 'Visnuprasad', Dhootapapeswar Industries Ltd., Paanvel-Kolaba, Panvel.

Puranik, P. G., 'Vishnuprasad', Dhootapapeshwar Industries Ltd., Paanvel-Kolaba, Panvel.

Puri, (Dr.) B. R., Dept. of Chemistry, University College, Hoshiarpur.

Puri, (Dr.) G. S., Ph.D., F.G.S., Ecologist, Forest Research Institute, New Forest P.O., Dehra Dun.

Puri, V., Prof. of Botany, Meerut College, Meerut.

- Purulekar**, (Miss) N. K., Biology Dept., Bhavans College, Andheri, Bombay.
Pusalkar, S. D., M.Sc., Technical Manager, M/s. Paragan Products (I) Ltd., 'Usha', 118, Shivaji Park, Bombay-18.
Pushkarnath, M.Sc., Ph.D., Assoc. I.A.R.I., Director, Central Potato Research Institute, Post Box No. 136, Patna.

Q

- Qureshi**, M. R. H., Asst. Cotton Botanist, Lalur, Hyderabad-Dn.

R

- Racine**, (Rev.) C., S.J., D.Sc., Professor of Mathematics, Loyola College, P.O. Cathedral, Madras-6.
Radhakrishna, B. P., B.Sc., F.G.S., Geologist in Charge, Bureau of Mineral Development, Bageshapura P.O., Mysore State.
Raghavan, N. G. S., Major, Asst Director, Malaria Institute of India, 22, Alipore Road, Delhi-2.
Raheja, P. C. (Dr.), Agronomist, Indian Agriculture Research Institute, New Delhi-12.
Rahman, A., Central Laboratories for Scientific & Industrial Research, Jamai Osmania, Hyderabad-Deccan.
Rahman, S. A., Professor of Physiology, Medical College, Mohalla Lingumpally, Hyderabad-Dn
Rai, R. N., Lecturer in Physics, Delhi University, Delhi.
Raikar, (Dr) R. K. Lecturer, Bombay Veterinary College, Parel, Bombay.
Raina, B. N., M.Sc., Geological Survey of India, 27, Chowranghee, Calcutta-13.
***Raj**, B. Sundara, Diwan Bahadur, M.A., Ph.D., F.N.I., Park View, Miller Road, Kilpauk, Madras.
Raj, Des. Indian Statistical Institute, 203, Barrackpore Trunk Road, Calcutta-35.
Rajderkar, E. B., M.Sc., Industrial Physicist, Commissariat Building, Hornby Road, Fort, Bombay.
Rajagopalan, C., M.Sc., Prof. & Head of the Dept. of Geology, Dr. A. C. College, Alagappa College P.O., Ramnad-Dist.
Rajagopal, K., M.Sc., M.B.B.S., Major, Associate Prof. of Biochemistry & Nutrition, All India Institute of Hygiene & Public Health, 110, Chittaranjan Avenue, Calcutta.
Rajagopalan, V. R., Director of Animal Husbandry, Chepank, Madras-5.
Rajan, (Prof.) S. V., Head, Dept. of Biology, J.S.S. & Science College, Dharwar.
Rajgarhia, Chand Mull, Giridih.
Rajlakshman, (Dr.) D. V., Reader in Statistics, Madras University, Madras.
Rajnath, M.Sc., D.I.C., Ph.D., F.N.I., Prof. and Head of the Dept. of Geology, and Geophysics, Hindu University, Banaras.
Rakshit, H., D.Sc., F.Inst.P., F.N.I., Prof., Dept. of Physics, Bengal Engineering College, P.O. Botanic Garden, Howrah.
Rakshit, (Prof.) P. C., Ph.D., Head of the Dept. of Chemistry, Presidency College, Calcutta.
Rakspal, (Dr.) R., Zoology Dept., Lucknow University, Lucknow.
Ram, Atma, D.Sc., F.N.I., Director, Central Glass & Ceramic Research Institute, Jadavpur College P.O., Calcutta-32.
Ram, Raja, Head of the Dept. of Geography, Govt. College, Rohtak.
Ramchandran, G. N., Dept. of Physics, Indian Institute of Science, Bangalore.

- Ramachandran, (Dr.) K.**, Central Laboratories for Scientific & Industrial Research, Hyderabad-Dn.
- Raman, G. A.**, B.Sc., F.R.I.C., Officer on Special Duty, Goodlass Wall (India) Ltd., Fergusson Road, Lower Parel, Bombay-13.
- Ramdas, L. A.**, M.A., Ph.D., F.N.I., Agricultural Meteorologist, Meteorological Office, Poona-5.
- Ramakrishna, K.**, Ph.D., Senior Lecturer in Botany, University Botany Laboratory, Madras-5.
- Ramanathan, K. R.**, Dewan Bahadur, M.A., D.Sc., F.N.I., Director, Physical Research Laboratory, Navarangapura, Ahmedabad-9.
- Ramanujam, S.**, M.A., Ph.D., F.N.I., Director, Central Rice Research Institute, Cuttack-4.
- Ramasarma, G. B.**, Ph.D., F.R.I.C., A.I.I.Sc., Chief of Research & Control Division, Raptakos, Brett & Co., Ltd., Worli, Bombay-18.
- Ranade, Shridhar Balkrishna**, B.A., M.Sc., Bombay Educational Service, Lecturer in Biology, 436, Bhagwat Bunglow, 15, Road, Khar, Bombay.
- Ranade, V. D.**, Lecturer in Zoology, M. S. University of Baroda, Babji Sadan, Soorsagar (North), Baroda
- Rangaswamy, (Prof.) S.**, Andhra University, Waltair.
- Rangan, V. A. K.**, B.A., F.R.E.S., No. 5, Gopalkrishna Road, Thyagarayanagar P.O., Madras-17.
- Rao, (Dr.) A. Narasinga**, Prof., Madras Institute of Technology, Chrompet, Madras.
- Rao, B. Rama**, M.A., D.I.C., F.G.S., F.N.I., Director, Mysore Geological Dept., 291, Srivilas, Visvesvarapur, Bangalore City.
- Rao, B. Rama**, Research Scholar, Central Laboratories for Scientific & Industrial Research, Jamai-Osmania P.O., Hyderabad-Dn.
- Rao, B. S. Madhava**, D.Sc., Principal, Central College, Bangalore.
- Rao, B. Sanjiva**, M.A., Ph.D., D.Sc., Radha Niwas, 10th Main Road, Bangalore-3.
- Rao, (Dr.) B. Subha**, M.A., LL.B., Ph.D., Adhyapak Nivas, Pratapganj, Baroda.
- Rao, Babu**, Chemistry Dept., Osmania University, Hyderabad-Dn.
- Rao, Balabheem**, Central Laboratories for Scientific & Industrial Research, Hyderabad-Dn.
- Rao, (Dr.) C. B.**, Principal, Govt. Training College, Rajahmundry, Andhra State.
- Rao, C. Venkata**, M.Sc., Lecturer in Botany, Andhra University, Waltair.
- Rao, D. Subha**, Dean, Faculty of Technology & Professor of Civil Engineering, Kala Bhavan, Baroda.
- Rao, J. C. Kameswara**, A12/35, Gagan Mahal Road, Domalguda, Hyderabad-Dn.
- Rao, Rao Sahib C. J. Dasa**, Andhra University, Waltair.
- Rao, G. Rama**, M.Sc., A.R.I.C., M.M.E.A., Govt. Technical College, Hyderabad-Dn.
- Rao, G. S. Raghunath**, B.Sc., M.B.B.S., D.Phil., Asst. Prof. of Pharmacology, University Medical College, Mysore, S.I.
- Rao, J. Joga**, Chemistry Dept., Osmania University, College of Science Hyderabad-Dn.
- Rao, K. H.**, M.Sc., Lecturer in Zoology, Andhra University, Waltair.
- Rao, (Dr.) K. Pampapathi**, M.A., Ph.D., M.N.B.A., Dept. of Zoology, Andhra University, Waltair.
- Rao, K. Rama**, Dist. Veterinary Officer, Parbhani, Hyderabad-Dn.
- Rao, (Dr.) K. Subha**, 95, Block 8A, Western Extension Area, Karolbagh, New Delhi.
- Rao, K. V. Krishnamurthy**, Managing Engineer, C/o. Chandra & Murti, Bhilwara (Rajasthan).
- Rao, K. Venkateswara**, D.Sc., Chemist, Geological Survey of India, Hyderabad Circle, A. C. Guards, Hyderabad-Dn.
- Rao, L. N.**, Ph.D., F.R.M.S., Prof. of Botany, Central College, Bangalore.

- Rao, L. Rama, M.A., F.G.S., F.A.Sc., F.N.I., Prof. & Head of the Dept. of Geology, University of Mysore, Central College, Bangalore.**
- Rao, M. R. A., Asst. Prof., Indian Institute of Technology, Kharagpur.**
- Rao, (Capt.) M. R. Lakman, G.B.V.C., P.G., H.I.D.R.I., District Veterinary Officer, Sardarpur.**
- Rao, M. V. Radhakrishna, M.B.B.S., Ph.D., Asst. Director, Haffkine Institute, Bombay-12.**
- Rao, Mandagire Bhardwaj Ramchandra, Chief Geophysicist, Geological Survey of India, 27, Chowringhee, Calcutta-13.**
- Rao, N. V. Subba, Prof. of Chemistry, Osmania University, Hyderabad-Dn.**
- Rao, P. S., B.Sc., M.R.S.A., 8/15, Aryanagar, Cawnpore.**
- Rao, P. V., Geologist, Geological Survey of India, Hyderabad Circle, A C. Guards, Hyderabad-Dn.**
- Rao, (Dr.) Raghavendra, Central Laboratories for Scientific & Industrial Research, Hyderabad-Dn.**
- Rao, S. Balakrishna, Navaratna Pharmaceutical Laboratories, Post Box 13, Cochin-2.**
- Rao, S. Neelakanta, Dept. of Chemical Technology, Hyderabad-Dn.**
- Rao, S. M. Jaya, Junior Lecturer in Statistics, Statistics Dept., S. J. Science Institute, Baroda.**
- Rao, S. R., Asst. Superintendent, Dept. Archaeology, Western Circle, Baroda.**
- Rao, S. R., M.Sc., D.Sc., Parasitologist, Civil Veterinary Dept., Bombay Veterinary College, Parel, Bombay.**
- Rao, S. Raghavender, L.M.S., D.T.M., D.P.H., D.Sc., Asst. Director, Public Health, A/9/316, Vithalwadi, Hyderabad-Dn.**
- Rao, S. Ramachandra, M.A., Ph.D., D.Sc., F.Inst.P., Prof. of Physics, Central College, Bangalore.**
- Rao, T. L. Narsimha, Central Laboratories for Scientific & Industrial Research, Hyderabad-Dn.**
- Rao, V. L. S. Prakasa, M.A., D.Phil., Senior Lecturer in Geography, Madras University, University Examination Hall, Madras-5.**
- Rao, Venkob, Central Laboratories for Scientific & Industrial Research, Hyderabad-Dn.**
- Rao, (Miss) V. Radha, Central Laboratories for Scientific & Industrial Research, Hyderabad-Dn.**
- Rao, V. Ramakrishna, Reader in Physics, Andhra University, Waltair.**
- Rao, Y. Ramchandra, Rao Bahadur, Retired Entomologist, 29, Nagasandya Road, Basavangudi, Bangalore-4.**
- Rath, (Dr.) R., Prof., Ravenshaw College, Cuttack.**
- Rau, A. Subba, B.A., D.Sc., F.R.M.S., (Retd.) Prof. of Zoology, 3111, Yadavagiri, V. V. Mohall, Mysore.**
- Ray, Anil Krishna, B.E., M.I.E., B.L., Civil Engineer, Chief Building Surveyor, Calcutta Corporation, 1/1, Fern Road, Ballygunge, Calcutta-17.**
- Ray, Anukul Chandra, M.Sc., 2, Panchanontola Street, P.O. Belur Math, Howrah.**
- Ray, Chapalendu, M.Sc., Geologist, Bird & Co., Calcutta, 110, Vivekananda Road, Suit No. 7, Calcutta-6.**
- Ray, Chittaranjan, Senior Scientific Asst., Central Drug Research Institute, Chatter Manzil Palace, Lucknow.**
- Ray, G. K., M.Sc., A.R.I.C., D.Phil., Asst. Research Officer, Dept. of Pharmacology, School of Tropical Medicine, Calcutta-12.**
- Ray, Harendra Nath, M.Sc., P.R.S., Ph.D., F.N.I., Officer-in-charge, Section of Parasitology, Indian Veterinary Research Institute, Mukteshwar-Kumaun.**
- Ray, J. C., M.D., Director, Indian Institute for Medical Research, P-27, Prinsep Street, Calcutta.**

- Ray, (Dr) J. N.**, Teddington Chemical Factory Ltd., Suren Road, Andheri, Bombay.
- Ray Chaudhari, N.**, B.Sc., I.C.S., Secretary, Ministry of Refugee & Rehabilitation, Auckland Road, Calcutta.
- Ray, N. C.**, M.Sc., Director, Agricultural Marketing Branch, Govt. of West Bengal, Writers Building, Calcutta.
- Ray, Priyada Ranjan**, M.A., F.N.I., Prof., Dept of Inorganic Chemistry, Indian Association for the Cultivation of Science, Jadavpur, Calcutta-32.
- Ray, R. C.**, D.Sc., F.N.I., F.I.I.Sc., F.N.I., Emeritus Prof. of Chemistry, B. M. Das Road, Patna-4.
- Ray, S. C.**, B.Sc., B.Sc.Tech., Chief Electrical & Mechanical Engineer, The Chirimiri Colliery Co., P.O. Chirimiri.
- Ray, S. N.**, M.Sc., Ph.D., Indian Veterinary Research Institute, Izatnagar.
- Ray, Siteshendra Nath**, L.M.E., M.Sc., Aesearch Asst., Physiology Dept., Bengal Veterinary College, Belgachia, Calcutta-37.
- Ray Chowdhury, Kartik**, M.Sc., C/o. Professor Macc, Dept. of Psychology, Birkbeck College, University of London, Malet Street, London, W.C. 1.
- Ray Choudhuri, S.**, M.Sc., Ph.D., F.L.S., Assoc. I.A.R.I., Asst. Virologist, Agricultural Research Institute, New Delhi.
- Raychaudhuri, S. P.**, D.Sc., Ph.D., F.R.I.C., F.N.I., Head of the Division of Agricultural Chemistry & Soil Sciences, Indian Agriculture Research Institute, New Delhi.
- Ray Chaudhuri, Sunil Kumar**, Lecturer in Geology, Calcutta University, 6, Mysore Road, Kalighat, Calcutta-26.
- Ray Chaudhury, Tarak Chandra**, M.A., B.L., Lecturer in Anthropology, Calcutta University, 32/B, Allenby Road, Calcutta-20.
- Razack, H. M. Abdul**, Chirag Ali Lane, Hyderabad-Dn.
- Ravalgaon Sugar Farm Ltd., The**, Ravalgaon, Nasik Dist.
- Reddy, D. V. Subba**, M.B.B.S., M.Sc., Prof. and Head of the Dept. of Physiology, Central Institute of Physiology, Medical College, Madras.
- Rege, Raghunath Dattaji**, Ph.D., A.I.I.Sc., Sugarcane Specialist, Sugarcane Research Scheme, Pedgaon, Post Nira R.S., Dist. Poona.
- Richharia, (Dr.) R. H.**, Economic Botanist to the Govt. of Bihar, Sabour, Bhagalpore.
- Rizvi, S. M. Tahir**, B.A., Ph.D., M.A., LL.B., F.R.G.S., F.R.M.S., Bar-at-Law, Chairman, Dept of Geography, Muslim University, Aligarh.
- Rode, K. P.**, M.Sc., Ph.D., F.A.Sc., F.G.M.S., Head of the Dept. of Geology, University of Rajputana, Udaipur.
- Rohatgi, Binay Krishna**, Chemist & Industrialist, 45, Armenian Street, Calcutta.
- Rohatgi, (Miss) Krishna Kamini**, M.Sc., Ph.D., Sir P. C. Roy Research Fellow, Dept. of Chemistry, University College of Science, 45, Armenian Street, Calcutta.
- Rohatgi, (Miss) Krishna Sudha**, M.Sc., 45, Armenian Street, Calcutta.
- Rohatgi, S. (Dr.)**, C/o. Hind Chemicals Ltd., Railbazar, Kanpur.
- Roy, A.**, M.Sc., P.R.S., Ph.D., Dept. of Physiology, U. P. College of Veterinary Science & Animal Husbandry, Mathura, U.P.
- Roy, A. K.**, B.Sc., B.A., Dy. Director General of Observatories, Meteorological Office, Poona-5.
- Roy, A. N.**, D.Sc., Dept. of Applied Chemistry, Indian Institute of Technology, Hijli, Kharagpur.
- Roy, A. N.**, B.A., L.M.F., Indian Institute of Research, P-27, Princep Street, Calcutta-13.
- Roy, (Dr.) B. C.**, Superintending Geologist-in-charge, Western Circle, Geological Survey of India, Botawala Chambers, Sir Pheroza Shah Mehta Road, Bombay.

- Roy, Benoy Kumar**, Branch Manager, Indian Telephone Industries Ltd., 22, Chittaranjan Avenue, Calcutta.
- Roy, Bidhan Rajan**, M.Sc., D.Phil., Senior Research Asst., Appl. Chemistry Dept., University College of Science, 92, Upper Circular Road, Calcutta-9.
- Roy, (Miss) Binapani**, M.A., Ed.D., Educational Officer, The U. S. Education Foundation in India, 17, Curzon Road, New Delhi.
- Roy, (Mrs.) Binapani**, M.A., C/o. Dr. S. C. Roy, Dept. of Applied Chemistry, University College of Science, 92, Upper Circular Road, Calcutta-9.
- Roy, Durlov Kumar**, Research Asst., University College of Science, 92, Upper Circular Road, Calcutta.
- Roy, Gautam Sankar**, Lecturer in Anthropology, Dept. of Anthropology, University of Calcutta, 35, Ballygunge Circular Road, Calcutta.
- Roy, Gouranga**, Dept. of Applied Chemistry, University College of Science, 92, Upper Circular Road, Calcutta 9.
- Roy, H. L.**, A.B., Dr.Ing., M.I.Ch.E., Prof-in-Charge of the Chemical Engineering Dept., College of Engineering & Technology, Jadavpur, Calcutta-32.
- Roy, J. K.**, B.Sc., C.E., M.I.S.I., A.M.I.E., Executive Engineer, East Midnapore Division, Midnapore, West Bengal.
- Roy, Jogabrata**, 11A, Bhabanath Sen Street, Calcutta-4
- Roy, Kamakshya Charan**, B.A., M.A.E., Engineer, M/s Electric Stores and Engineering Co., 13A, Russell Street, Calcutta.
- Roy, N. B.**, M.B., D.M.R.T.R.C.P. & S., Prof. of Radio Therapy, University of Calcutta, & Head of the Dept. of Radio Therapy, Medical College Hospital, 23, Camac Street, Calcutta-16.
- Roy, (Major) N. K.**, M.B., D.P.H., Ex. I.M.S., Director, M. P. Vaccine & Public Health Institute, Nagpur-3.
- Roy, N. K.**, M.B., Bengal Immunity Research Institute, 39, Lower Circular Road, Calcutta-16.
- Roy, (Dr.) R. P.**, Prof. & Head of the Dept. of Botany, Patna University, Patna-5.
- Roy, R. S.**, M.Sc., A.M.S.S., Horticulturist, Bihar, P.O. Sabour, Bhagalpore, Bihar.
- Roy, Rathindra Nath**, M.Sc., Research Student, Dept. of Physiology, University College of Science, 92, Upper Circular Road, Calcutta.
- Roy, S.**, Superintendent, Coke Ovens, 5, Office Road, Jadavpur.
- Roy, S.**, Prof. of Geology, Presidency College, Calcutta
- Roy, (Dr.) S. C.**, Dept. of Applied Chemistry, 92, Upper Circular Road, Calcutta-9.
- Roy, S. K.**, B.Sc., A.M.I.E.E., Reader, Kala-Bhavan, Baroda.
- Roy, Sarojendra Nath**, M.Sc., D.Phil., Psychology Dept., University College of Science, 92, Upper Circular Road, Calcutta
- Roy, Satyendra Prasad**, Tea Planter, Post Box 59, Babupara, Jalpaiguri.
- Roy, Sudhansu Kumar**, M.Sc., Ph.D., D.I.C., Bose Research Institute, 93, Upper Circular Road, Calcutta.
- Roy, (Dr.) S. K.**, Chief Research Officer, Central Water Power and Research Station, Poona.
- Roy, Supriya**, M.Sc., Jr. Research Asst., C. S. I. R., Dept. of Geology, Calcutta University, Presidency College, Calcutta.
- Roy, Surendra K.**, M.E.E., College of Engineering & Technology, P.O. Jadavpur College, Calcutta-32.
- Roy Chowdhury, Amitava**, M.Sc., Bengal Immunity Research Institute, 39, Lower Circular Road, Calcutta-16.
- Roy Chowdhury, Anil Baran**, 16, Lansdowne Terrace, P.O. R. B. Avenue, Calcutta.
- Roy Chowdhury, Bhuban Mohan**, Physiology Dept., University College of Science, 92, Upper Circular Road, Calcutta.

- Roy Chowdhury, K.**, Specialist & Pioneer in the Manufacture of Analytical Balances in India, Mg. Director, Keray Ltd., S17/335, Nadeswar, Banaras Cantt.
- Roy Chowdhury, P. K.**, Senior Chemist, Processing Dept., Kassipur Co., Ltd., P.O. Alambazar, Dt. 24-Parganas.
- Roy Chowdhury, Sambhu Nath**, Lecturer in Zoology, Presidency College, Calcutta.
- Roy Choudhury, Sudhir Kumar**, Director, M/s. Artium Natural Sciences Ltd., 6, Mangoe Lane, Calcutta.
- *Rubugunday, R. K.**, M.A., Prof. of Mathematics, Saugor University, 12, Saugor Cantt., King's Road, C.P.
- Rudra, J. N.**, Professor, Dept. of Biology, Presidency College, Calcutta.
- Rudra, (Mrs.) Leena**, 1, Shibnarain Das Lane, Calcutta-6.
- Rudra, M. N.**, Prof. of Medical Chemistry, Darbhanga Medical College, P.O. Laheria Sorai, Bihar.

S

- Sabharwal, S.**, Continental Trading Agency, P-27, Princep Street, Calcutta.
- Sadasivan, T. S.**, M.Sc., Ph.D., Director, The University Botany Laboratory, Triplicane P.O., Madras-5.
- Sadashivaiah, (Dr.) M. S.**, Senior Lecturer in Mineralogy & Petrology, Indian School of Mines & Applied Geology, Dhanbad.
- *Sadgopal, D.Sc.**, F.R.I.C., F.R.H.S., F.C.S., Senior Research Officer-in-charge, Chemist of Forest Product Branch, Forest Research Institute, New Forest P.O., Dehra Dun.
- Sadhu, (Dr.) D. P.**, L.M.F., M.Sc., Ph.D., Head of the Dept. of Physiology & Nutrition, Bengal Veterinary College, Calcutta.
- Sagar, Lakshmi, M.Sc.**, Proprietor, The Oriental Science Apparatus Workshop, Amballa Cantt.
- Saha, Ajit Kumar, M.Sc.**, Prof. of Geology, Presidency College, Calcutta.
- Saha, Amarendra Nath, M.Sc.**, Lecturer, Applied Chemistry Dept., University College of Science, 92, Upper Circular Road, Calcutta.
- Saha, C. C.**, 45, Moti Sil Street, Calcutta-13.
- Saha, J. C.**, Prof. of Biology, Govt. College, Darjeeling.
- Saha, Kamakhya Charan, M.Sc.**, C/o. National Industrial Trading Co., 71A, Netaji Subhas Road, Calcutta.
- Saha, N. K.**, M.Sc., Dr. Nat., Dept. of Physics, University of Delhi, Delhi.
- Saha, Sachindra Prosad**, Chartered Engineer, P. 1/A, Rash Behari Avenue, Calcutta.
- Saha, Srish Kumar, M.Sc.**, Research Chemist, B. C. P. W., 164, Maniktolla Main Road, Calcutta.
- Sahana, D. B.**, Kodarma P.O., Hazaribagh Dist.
- Sahni, (Dr.) M. R.**, M.A., Ph.D., D.Sc., Geological Survey of India, 18, Clyde Road, Lucknow.
- Saharia, (Dr.) G. S.**, Reader in Chemistry, University of Delhi, Delhi.
- Sahasrabudhe, M. B.**, Ph.D., Biochemist, Biology Division, Atomic Energy Commission, Govt. of India, Indian Cancer Research Centre, Parel, Bombay-12.
- Sahasrabudhe, (Dr.) R. H.**, Dept. of Chemistry, College of Science, Hindu University, Banaras.
- Sahasrabudhe, Y. S.**, Asst. Geologist, Geological Survey of India, Botawala Chambers, Sir P. Mehta Road, Fort, Bombay.
- Sahib Ram, M.A.**, Prof., Dept. of Mathematics, Indian Institute of Technology, Kharagpur.
- Sahu, Virendra Kumar**, Government of India Scholar, Dept. of Biochemistry, Nagpur University, Nagpur.

- Sahukar**, Rama Murty, L.E., A.M.I.S.E., Supervisor, Hirakud Dam Project, Double Storey 1st Class Rest House, Hirakud P.O., Sambalpur.
- Saksena**, (Dr.) J. S., Demonstrator in Physiology, K. G. Medical College, Lucknow.
- Saksena**, (Dr.) K. M., Dept. of Mathematics, University of Saugor, Saugor, M.P.
- Saksena**, Ram Kumar, D.Sc., F.N.I., Dept. of Botany, Allahabad University, Allahabad.
- Saksena**, Shivadaya, M.A., M.Sc., Ph.D., Prof. & Head, Botany Dept., Durbar College, Rewa.
- Saletore**, S. A., B.Sc., A.I.I.Sc., A.R.I.C., Ph.D., Asst. Director, Central Laboratories for Scientific & Industrial Research, Distillery Compound, Narayanguda, Hyderabad-Dn
- Salooja**, T. R., Salooja Bros., 209, Bazaria, Ghaziabad, U.P.
- Salvi**, N. P., Chemistry Dept., Faculty of Science, M. S. University, Baroda.
- Samantarai**, B., M.Sc., Ph.D., D.I.C., Prof. of Botany, Ravenshaw College, Cuttack-3.
- Samudra**, R. B., B.Sc., Chemist (Pharmacy), Narang Industries Ltd., Nawabganj Sugar Factory P.O., Gonda.
- Sane**, J. B., M.Sc., A.R.I.C., "Kalpana", 96, J. P. Nagar, Goregaon, B. S. D., Bombay-4.
- Sane**, Yeshwant Keshav, Demonstrator in Botany, Ganeshwadi, Baroda.
- Sanitex Chemical Industries Ltd.**, The, Chemical Industries P.O., Industrial Area, Gorwa Road, Baroda-3.
- Sankaran**, C. R., Reader-in-charge of Phonetic Laboratory, Deccan College Research Institute, 10, Connaught Road, Poona-1.
- Sankaran**, (Dr.) G., P20, Gariahat Road, Calcutta.
- Santapau**, H., Rev., St. Xavier's College, Fort, Bombay
- Sanyal**, A. T., B.Sc.Ag., Assoc.I.A.R.I., Agronomist, Jute Agriculture Research Institute, Barrackpore, W. Bengal.
- Sanyal**, B. B., C/o. Sri Chandra Sekhar Lahiri, 21, Lackmanganj, Lucknow.
- Sanyal**, Jyotirmoy, M.Sc., Lecturer in Physics, Biswa Bharati, Santiniketan.
- Sanyal**, Paritosh, M.Sc., Assoc.I.A.R.I., Offg. Asst. Botanist, Jute Agriculture Research Institute, Barrackpore, 24-Parganas.
- Sarabhai**, (Mrs.) Mrinalini, C/o. Vikram A. Sarabhai, Post Box 28, Ahmedabad.
- Sarabhai**, Vikram A., M.A., Ph.D., Prof. of Cosmic Ray Physics, Physical Research Laboratory, Navrangpura, Ahmedabad.
- *Sarbadhikary**, Sachindra, B.Sc., M.B., M.D., 5/1, Lower Circular Road, Calcutta-20.
- Sarkar**, A. C., B.Sc., D.I.I.C., A.M.I.E., Superintendent, Generation, Dishergarh & Associated Power Co. & Sanctoria, Dishergarh P.O., Burdwan.
- Sarkar**, Anup Suundar, A.M.I.Mech.E., C/o. Bharat Pump Machinery Ltd., 20, Netaji Subhas Road, Calcutta-1.
- Sarkar**, B. K., M.I.Metal, Chartered Engineer, Councillor, Calcutta Corporation and Dy. Chairman, Town Planning & Improvement Committee, Director, Agricultural Machinery Manufacturing Corporation Ltd., 14/2, Bhabanath Sen Street, Calcutta.
- Sarkar**, (Dr.) Bijali Behari, Head of the Dept. of Physiology, University College of Science, 92, Upper Circular Road, Calcutta.
- Sarkar**, (Miss) Binita, 14/2, Bhaba Nath Sen Street, Calcutta.
- Sarkar**, (Miss) Bithika, 14/2, Bhaba Nath Sen Street, Calcutta.
- Sarkar**, D. N., B.Sc., A.M.I.E., Chartered Engineer, 79/B, Nimtolla Ghat Street, Calcutta-6.
- Sarkar**, H. L., M.Sc., Zoology Dept., Delhi University, Delhi-8.
- Sarkar**, N. G., Director, Scientific Indian Glass Co., Ltd., 98, Christopher Road, Calcutta.

- Sarkar, (Prof.) P. B.**, Dept. of Chemistry, Rash Behari Ghosh Prof. of Chemistry, University College of Science, 92, Upper Circular Road, Calcutta-9.
- Sarkar, (Prof.) R.**, 30/B, Kalighat Road, Kalighat, Calcutta-26.
- Sarkar, S. N.**, Ph.D., D.Phil., Prof. of Organic Chemistry and Biochemistry, N. R. Sircar Medical College, C/o. Dept. of Chemistry, Calcutta Medical College, Calcutta.
- Sarkar, (Dr.) S. S.**, 16/2/E, Station Road, Calcutta-19.
- Sarkar, Santosh Kumar**, M.Sc., Botany Dept., University College of Science, 35, Ballygunge Circular Road, Calcutta.
- Sarkar, Satya Ranjan**, B.Sc., Dip. Diet., A.I.C., Chemist, Public Health Laboratory, Municipal Buildings, Darjeeling.
- Sarkar, (Mrs.) Sunity**, 33/3, Lansdowne Road, Calcutta.
- Sarkar, (Mrs.) Uma**, Director, Agricultural Machinery Manufacturing Corpn., Ltd., 38/1, Bose Para Lane, P.O. Baghbazar, Calcutta.
- Saraswati Sugar Mills, The**, Jamna Nagar, Amballa Dist.
- Sarin, (Dr.) J. L.**, Asst. Secretary, National Institute of Sciences of India, Mathura Road, New Delhi
- Sarma, (Dr.) A. V. S.**, 10, Bhagirathianmal Street, T. Nagar, Madras-17.
- Sarma, Jyotirmoyee**, Ph.D., Sarma House, Sahapur P.O., Calcutta-38.
- Sarma, (Srimati) Kamalmani**, M.Sc., Asst. Geophysicist, Geological Survey of India, 27, Chowringhee, Calcutta
- Sarma, (Dr.) P. S.**, M.Sc., Ph.D., F.R.I.C., University Biochemistry Dept., A. C. College, Madras-25
- Sarma, Rama Kanta**, A.M.I.E.E., Chief Electrical Engineer, M/s. Guest, Keen, Williams Ltd., 97, Andul Road, Salimar, Howrah
- Sastry, B. J.**, B.E., A.M.I.E., 5/III B, Maithol, D. V. C., Manbhum.
- Sastry, N. S. N.**, Head of the Dept. of Social Sciences, Indian Institute of Science, Bangalore-3
- Sastry, (Dr.) N. S. R.**, Director of Statistics, Reserve Bank of India, Post Box No. 1036, Bombay-1.
- Sastri, R. L. N.**, Dept. of Botany, Andhra University, Waltair
- Sastry, V. V. K.**, M.Sc., A.R.I.C., Managing Director & Chief Chemist, The Eastern Technical Laboratories Ltd. 6/C, Mowbray's Road, Madras-14.
- Sastri, Varilala Vasudeva**, M.Sc., F.G.M.S., Geological Survey of India, 27, Chowringhee, Calcutta-13.
- Savant, Ashok Sitaram**, C/o. Bharat Glass Works, Belgharia P.O., 24-Parganas.
- Savant, Nanasaheb Gangaram**, Dept. of Chemistry, Faculty of Science, M. S. University, Baroda.
- Savant, Prabod Jayaram**, C/o. Bharat Glass Works, Belgharia P.O., 24-Parganas.
- Savant, Sitaram Janaron**, C/o. Bharat Glass Works, Belgharia, 24-Parganas.
- Sawhney, Rai Bahadur Kalidas**, M.Sc., Secretary, Indian Central Cotton Committee, 14, Nicol Road, Ballard Estate, Fort, Bombay.
- Saxsena, E. R.**, Central Laboratories for Scientific and Industrial Research, Hyderabad-Dn.
- Saxena, M. C.**, Lecturer in Physics, Lucknow University, Lucknow.
- Saxena, S. P.**, M.A., M.Sc., F.P.S. (Lond.), Lecturer in Physics, Joint Service Wing, National Defence Academy, P.O. Clement Town, Dehra Dun.
- Sayeed-ud-Din, M.**, M.A., B.Sc., F.R.M.S., Prof. of Botany, Principal, College of Science, Osmania University, P.O. Lallaguda, Hyderabad-Dn.
- Seal, Srish Chandra**, M.B., D.P.H., F.A.P.H.A., Professor of Epidemiology, All India Institute of Hygiene & Public Health, Calcutta.
- Sen, A. B.**, M.Sc., Ph.D., Reader in Chemistry, Lucknow University, Lucknow.
- Sen, A. N.**, M.A., B.Sc., M.I.E., 32, Ballygunge Place, Calcutta.
- Sen, Alok**, M.Sc., Prof. of Botany, Vidyasagar College, 39, Sankar Ghose Lane, Calcutta.

- Sen, Amitabha**, M.Sc., Ph.D., Bose Research Institute, 93/1, Upper Circular Road, Calcutta-9.
- Sen, Amitava**, M.B., Asst. Surgeon, Medical College, Calcutta, 33/D, Eden Hospital Road, Calcutta.
- Sen, Asoke Kumar**, M.Sc., Mg. Director, East India Pharmaceutical Works Ltd., 11/1/4, Russa Road, 3rd Floor, Calcutta-26.
- Sen, (Prof.) B. R.**, Dept. of Civil Engineering, Indian Institute of Technology, Kharagpur.
- Sen, Basiswar**, B.Sc., Director, Vivekananda Laboratory, Almora, U.P.
- Sen, Bibhuti Bhusan**, D.Sc., F.N.I., Research Prof. of Mathematics, Birla College of Science, Pilani, Rajasthan.
- Sen, (Prof.) Binayendra Nath**, "Mithapukur", Burdwan.
- Sen, Birojananda**, A.M.E.E., B.E.E., 28, Bepin Pal Road, Calcutta-26.
- Sen, (Miss) Chitra**, M.Sc., Anthropology Survey of India, Govt. of India, 6, Turf Road, Calcutta-25.
- Sen, (Dr.) D. K.**, Dept. of Chemical Technology, University of Bombay, Bombay-9.
- Sen, Dharanidhar**, M.Sc. Lecturer, Dept. of Anthropology, Calcutta University, 91/11-A, Tollygunge Road, Calcutta-33.
- Sen, H.**, Geologist, Prospecting Dept., Tata Iron & Steel Co., Ltd., Jamshedpur.
- Sen, Harakali**, Chief Coal Inspector, Jamaduba, P.O. Jealgort, Dt. Manbhum.
- Sen, Hari Pada**, Asst. Prof. of Physics, Jadavpur Engineering College, Jadavpur College P.O., Calcutta-32.
- Sen, Indra**, M.A., Ph.D., Sri Arabinda Asram, Pandichary.
- Sen, (Capt.) J. K.**, M.B., D.T.M., 18, Kashinath Dutt Road, Baranagore, 24-Parganas.
- Sen, J. M.**, M.Ed. (Leeds), B.Sc. (Cal.), T.D. (Lond.), Dip. Ed. (Oxford), F.R.G.S., F.N.I., Head of the Dept. of Education, Calcutta University, Block F, No. 108/J, New Alipore, Calcutta-33.
- Sen, J. R.**, M.H.E.A., M.I.E.E., A.M.I., Engineer, Tribeni Tissue Ltd., Tribeni, Hooghly.
- Sen, K. B.**, M.Sc., A.I.C., Chemist-in-charge, M/s. Bird & Co.'s Research Dept., Chartered Bank Buildings, Clive Street, Calcutta.
- Sen, K. P.**, Mining Engineer & Manager, Pure Ganeshpur College, Nawagarh P.O., Dt. Manbhum.
- Sen, Kum Kum**, Prof. of Physics, Chandernagore College, Chandernagore.
- Sen, M.**, D.Sc., A.R.I.C., Quinologist to the Govt. of W. Bengal, Mangpoo, Darjeeling.
- Sen, (Sm.) Malina**, C/o. Sri J. R. Sen, Tribeni Tissue Ltd., Tribeni, Hooghly.
- Sen, Milan Kumar**, Asst. Mining Engineer, Volkart Brothers Ltd., 37/5, Russa Road, Calcutta-16.
- Sen, N. K.**, M.A., D.Sc., F.R.I.C., F.N.I., Director, Forensic Science, Laboratory, Govt. of West Bengal, Chemistry Block Medical College, Calcutta-12.
- Sen, Nalinbihari**, M.Met., B.Sc., F.R.I.C., F.I.N., Technical Asst. to Director, Tata Industries Ltd., 34, Circuit House Area, Jamshedpur.
- Sen, Nikhil Ranjan**, D.Sc., Ph.D., Dept. of Applied Mathematics, University College of Science, 92, Upper Circular Road, Calcutta-9.
- Sen, Nirmal Chandra**, A.M.E.E., Works Manager, Engineer, The Bengal Electric Lamp Works Ltd., Jadavpur, Calcutta-32.
- Sen, Nirad Kumar**, M.Sc., D.Phil., Ph.D., Botanical Laboratory, Indian Institute of Technology, Kharagpur.
- Sen, P. B.**, Dept. of Physiology, University College of Science, 92, Upper Circular Road, Calcutta.
- Sen, P. K.**, M.Sc., Ph.D., D.I.C., F.B.S., Khaira Prof. of Agriculture, Calcutta University, University College of Science, 35, Ballygunge Circular Road, Calcutta-19.

- Sen, (Dr.) P. K.**, Physician-in-charge, (Chest Dept.), Medical College Hospital, Calcutta.
- Sen, Parimal**, B.Sc., Indian Institute of Technology, Kharagpur.
- Sen, Purnendu**, M.Sc., Ph.D., D.I.C., Entomologist, Directorate of Health Services, Govt. of W. Bengal, School of Tropical Medicine, Calcutta.
- Sen, R. N.**, M.A., Ph.D., Hardinge Professor of Higher Mathematics, Calcutta University, 30, Mohan Bagan Lane, Block II, Calcutta-4.
- Sen, Ranjit Kumar**, M.Sc., Research Asst., Indian Association for the Cultivation of Science, Jadavpur.
- Sen, S. C.**, Agriculturist & Industrial Chemist, 10, Chowringhee, Calcutta.
- Sen, S. C.**, D.Sc., F.R.I.C., Asst. Prof. of Sugar Chemistry, Indian Institute of Sugar Technology, Kanpur.
- Sen, (Dr.) S. K.**, Economic & Statistical Adviser, Ministry of Food & Agriculture, Jamnagar House, New Delhi.
- Sen, S. K.**, M.Sc., Hotel Savoy, 27, Sashi Bhusan Dey Street, Calcutta-12.
- Sen, S. N.**, Geologist, Geological Survey of India, 27, Chowringhee, Calcutta-13.
- Sen, S. N.**, Indian Association for the Cultivation of Science, Jadavpur, Cal.-32.
- Sen, (Dr.) S. R.**, Economic & Statistical Adviser, Ministry of Food & Agriculture, Jamnagar House, New Delhi.
- Sen, Sachindra Mohan**, M.Sc., Ph.D., M.I.R.E., Reader in Telecommunications, Faculty of Technology, M. S. University, Baroda.
- Sen, Sambhu Nath**, Statistician, Jute Agriculture Research Institute, Barrackpore.
- Sen, Saroj Kumar**, M.B.B.S., C/o. Sri S. P. Sen, Manager, B.C.P.W. Ltd., 164, Manicktollah Main Road, Calcutta.
- Sen, Satindra Kumar**, Prof. of Physiology, Vice-Principal, R. G. Kar Medical College, Calcutta.
- Sen, Satya Prasanna**, M.Sc., Manager and Secretary, Bengal Chemical & Pharmaceutical Works Ltd., 164, Manicktollah Main Road, Calcutta.
- Sen, Sourindra Nath**, D.Sc., Dept. of Geology, Calcutta University, Geological Laboratory, Presidency College, Calcutta.
- Sen, Subir**, 41/E, Palm Avenue, Calcutta-19.
- Sen, (Mrs) Sudha**, Honorary Secretary, All India Women's Conference, Calcutta Branch, Block No. F. 108/J, New Alipore, Calcutta-33.
- Sen, Sudhir Chandra**, M.Sc., Agronomist, Division of Agronomy, Indian Agriculture Research Institute, New Delhi.
- Sen, Triguna**, Dr. Ing. A.M.M.E., A.M.I.E., Principal, College of Engineering & Technology, P.O. Jadavpur College, Calcutta-32.
- Sen, (Miss) Usha**, M.A., Cartographer, Dept. of Geography, Calcutta University, Calcutta-12.
- Sen Gupta, Ananta Mohan**, Lecturer, Bengal Engineering College, 243, G. T. Road, Shibpur, Howrah.
- Sen Gupta, Bimal Chandra**, Sen Gupta Electroplating Works, 84, Dharamtollah Street, Calcutta.
- Sen Gupta, C. M.**, Section of Parasitology, Indian Veterinary Research Institute, Izatnagar, Bareilly.
- Sen Gupta, Dinesh Chandra**, 17A, Gopal Nagar Road, Calcutta-27.
- Sen Gupta, (Dr.) H. M.**, Lecturer in Pure Mathematics, University of Calcutta, Darbhanga Building, Calcutta.
- Sen Gupta, Harashit**, National Institute of Sciences of India, Muthra Road, New Delhi.
- *Sen Gupta, J. C.**, M.Sc., Dr. Phil., Nat., Principal, Presidency College, Calcutta.
- Sen Gupta, K.**, M.Sc., Ph.D., Deputy Director of Agriculture, Northern Range, Jalpaiguri.
- Sengupta, M.**, B.Sc., C.P.E., M.I.E.E., M.I.E., A.M.I.Mech.E., F.I.P.S., Principal, Engineering College, Banaras Hindu University, Banaras.

- Sen Gupta**, Manik Lal, M.Sc., Bengal Immunity Research Institute, 39, Lower Circular Road, Calcutta-16.
- Sen Gupta**, N. D., Physics Dept., Ramnarayan Ruia College, Bombay-19.
- Sen Gupta**, Nirmal Kumar, Chemical Plant & Equipment Ltd., 7, Lower Chitpur Road, Calcutta-1.
- Sen Gupta**, P. C., M.B., Officer-in-charge, Kalazar Research Dept., School of Tropical Medicine, Chittaranjan Avenue, Calcutta-12.
- Sen Gupta**, P. N., M.Sc., D.Phil., A.R.I.C., Biochemist, Dept. of Anthropology, Govt. of India, Indian Museum, 27, Chowringhee, Calcutta-13.
- Sen Gupta**, (Dr.), R., Dept. of Chemistry, Indian Institute of Technology, Kharagpur.
- Sen Gupta**, (Sm.) Rama, 8/1, Abdul Rasul Avenue, Calcutta-26.
- Sen Gupta**, S. C., 1/C, Injection Dept., The Pratap Ayaurbedic Pharmacy Ltd., Akali Market, Amritsar.
- Sen Gupta**, Sadashiv, 90, Basanta Roy Road, Kalighat P.O., Calcutta.
- Sen Gupta**, Sudhir Ranjan, B.Sc., Ph.D., A.M.I.E., Director, Indian Institute of Technology, Kharagpur.
- Seshachar**, B. R., D.Sc., F.Z.S., Prof. of Zoology, Dept. of Zoology, Central College, Bangalore.
- Seshadri**, T. R., M.A., Ph.D., F.I.C., Head of the Chemistry Dept., University of Delhi, Delhi.
- Seshagiri**, P. V. V., M.Sc., Reader in Botany, Andhra University, Waltair.
- Seshaiya**, R. V., M.A., Prof. of Zoology, Annamalai University, Annamalainagar.
- Seth**, B. R., M.A., Ph.D., D.Sc., Prof. of Applied Mathematics, Indian Institute of Technology, Kharagpur.
- Seth**, Govind Ram, Prof. of Statistics, Indian Council of Agricultural Research, Man Singh Road, New Delhi.
- Sethi**, Mehra Chand, Prof. of Botany, C/o. Civil Hospital, Sirsa, E. P.
- Setna**, S. B., Ph.D., F.R.M.S., Director of Fisheries, Taraporevala Aquarium, Netaji Subhas Road, Bombay-2.
- Sethan**, (Dr.) Suresh, Reader in Organic Chemistry, Sayaji Jubilee Science Institute, M. S. University of Baroda, Baroda.
- Sett**, Sudhansu, B.Sc., M.B., 3, Sir Hariram Goenka Street, Calcutta-7
- Shabde**, N. G., D.Sc., Principal, M. Mahavidyalaya, Jabulpore.
- Shah**, C. C., Senior Lecturer in Mathematics, Faculty of Science, M. S. University, Baroda
- *Saha**, C. C., M.Sc., Ph.D., F.R.I.C., Professor of Chemistry and Head of the Division of Animal Nutrition & Dairy Science, Institute of Agriculture, Anand. W. Railway
- Shah**, (Dr.) Chimanlal B., D.Sc., Chief Chemist, Alembic Chemical Works Co., Ltd., Baroda.
- Shah**, Chimanlal Jethalal, Lecturer in Chemistry, S. J. Science Institute, Station Road, Baroda.
- Shah**, J. J., Lecturer in Biology, M. T. B. College, Surat.
- Shah**, K. S., Junior Lecturer in Mechanical Engg., Sidhanth College, Sidhanth Road, Baroda.
- Shah**, Kantilal A., M.B.B.S., Chief Medical Officer, Gujrat University, 21, Jain Society, Ahmedabad-6.
- Shah**, Kantilal Devchand, Teaching Senior Lecturer in E.E., Faculty of Technology (including Engineering), Kala Bhaban, Baroda.
- Shah**, Lalchand Bhailal, B.Sc., B.H.O., M.Sc., Tech., Prof. & Head of the Dept. of Mechanical Engineering, Faculty of Technology (including Engineering), M. S. University, Baroda.
- Shah**, M. S., M.Sc., Ph.D., D.I.C., Prof. of Chemistry, Gujrat College, Ahmedabad
- Shah**, Manharlal M., L.C.P.S., Sultanpura, Baroda.

- Shah**, Manubhai Jaikhandas, Lecturer in Chemistry, Faculty of Science, S. J. Science Institute, Baroda.
- Shah**, Manubhai L., Head of the Dept. of Chemistry, M. N. College, Visnagar.
- Shah**, Maganlal Vadilal, Tutor in Mathematics, Faculty of Science, M. S. University, Baroda.
- Shah**, Mohanlal Mansukhlal, M.Sc., C/o. S. M. Shah & Co., Chemist, Raopura, Baroda.
- Shah**, (Dr.) N. M., Dept. of Chemistry, Gujrat College, Ahmedabad, Bombay Presidency.
- Shah**, Nathalal Himatlal, Chemistry Dept., Faculty of Science, M. S. University, Baroda.
- Shah**, Navinchandra A., Staff Member, Faculty of Technology, Palace Road, Opp. Hathi Pole, Baroda.
- Shah**, P. G., M.A., B.Sc., C.I.E., 'Lalit Kunj', 11th Road, Khar, Bombay-21.
- Shah**, (Miss) R., Chief Agricultural Research Officer, Harry Ferguson of India Ltd., Bangalore.
- Shah**, R. C., M.Sc., Ph.D., A.I.I.Sc., Professor of Organic Chemistry, The Institute of Science, Fort, Bombay.
- Shah**, Raman V., Lecturer, Dept. of Zoology, Faculty of Science, M. S. University, Baroda.
- Shah**, S. M., M.A., Ph.D., D.Litt., F.N.I., Reader in Mathematics, Muslim University, Aligarh.
- Shah**, Vinoodkant Chunilal, Dept. of Zoology, Faculty of Science, M. S. University, Baroda.
- Shaikhamahmud**, (Miss) Fatema S., 73, Jehangir Mansion, 2nd Floor, Flat No. 5, Huges Road, Bombay-7.
- Shankar**, Jagdish, M.Sc., Ph.D., A.R.I.C., Kenilworth, 53, Pedder Road, Bombay-26.
- Sharma**, (Dr.) D., C/o. Dr. Hardevi Sharma, Arogya Sadan, Hathras, U. P.
- Sharma**, D. R., M.Sc., C/o. N. Owers Eq., 8, Starkey Town, Nagpur.
- Sharma**, Pt. Dina Nath, Proprietor, Krishna Models Mfg. Co., 24, Naiwala, Karolbagh, New Delhi-5.
- Sharma**, Ganpati Prasad, M.Sc., Ph.D., Ph.D. (Edin.), Reader in Zoology, Punjab University College, Hoshiarpur.
- Sharma**, J. L., M.A., D.Sc., Vice-Principal, Govt. Degree College, Nainital.
- Sharma**, Mrs. Maitreyi, Krishan Bhawan, Krishan Nagar, Hoshiarpur.
- Sharma**, N. L., Prof. of Geology, Indian School of Mines & Applied Geology, Dhanbad.
- Sharma**, (Dr.) P. N., Prof. of Physics, Lucknow University, Lucknow.
- Sharma**, R. K., Head of the Chemistry Dept., S. D. College, Ambala Cantt.
- Shastri**, N. A., M.Sc., F.A.Sc., Mahakoshal Mahavidyalaya, Jabbalpur.
- ***Shrivastava**, H. N., B.Sc., M.I.E.E., M.I.E., F.I.P.S., Additional Chief Engineer, Posts & Telegraphs, Jabbalpur.
- Shrivastava**, R. N., B.Sc., F.G.M.S., Geological Survey of India, 27, Chowringhee, Calcutta.
- Sheth**, N. M., Lecturer in Chemistry, Faculty of Science, M. S. University, Baroda.
- Short**, G. V., Col., M.R.C.V.S., Veterinary Service Dept., Imperial Chemical Industries (India) Ltd., 18, Strand Road, Calcutta-1.
- Shree Hanuman Sugar Mills Ltd.**, 178, Harrison Road, Calcutta.
- Shroff**, H., C/o. Tata Chemicals Ltd., Mithapur, Okhamandal, W. Railway.
- Shroff**, T. R., Testing Dept., Tata Hydro Electric Power Supply Co. Ltd., Lalwadi, Bombay-12.
- Shukla**, K. D., Geological Survey of India, 27, Chowringhee, Calcutta-13.
- Shukla**, Rudra Datta, M.Sc., Chodhari Mohalla, Ajmer.

- Shukla, S. N.**, M.Sc., Ph.D., A.R.I.C., Reader, Chemistry Dept., Lucknow University, Lucknow.
- Sidhu, G. S.**, M.Sc., B.Sc., Ph.D., Scientific Officer, Central Laboratories for Scientific & Industrial Research, P.O. Jamai Osmania, Hyderabad-Dn.
- Sikka, (Dr.) S. M.**, Head of the Division of Botany, Indian Agriculture Research Institute, New Delhi-12.
- Singh, B. N.**, D.Sc., F.N.I., F.N.A.S., F.A.Sc., Crop Physiologist to Govt. of U.P., Institute of Crop Physiology, Dilkhusa, Lucknow
- Singh, B. N.**, D.Sc., Prof. of Physics, Science College, Patna.
- Singh, Baldev**, B.Pharm., B.Sc., Central Laboratories for Scientific & Industrial Research, P.O. Jamai Osmania, Hyderabad-Dn.
- Singh, Bawa Kartar**, M.A., Sc.D., F.I.C., F.N.I., Hon'y. Research Prof. of Chemistry, Banaras Hindu University, Banaras.
- Singh, Chhotey**, Senior Entomological Research Asst., Section of Entomologist to the Govt. of U.P., Kanpur.
- Singh, Prem**, Palaeobotanical Investigation of India Coals, C.S.I.R., C/o. Birbal Sahni Institute of Palaeobotany, 53, University Road, Lucknow.
- Singh, R. P.**, M.B., M.S., Prof. of Anatomy, M. G. M. Medical College, Indore.
- Singh, R. N.**, Chief Conservator of Forests, U.P., Nainital.
- Singh, (Dr.) S. N.**, Professor of Zoology, College of Science, Osmania University, Hyderabad-Dn.
- Singh, Sardar Kartar**, Asst. Blast Fce Manager, Hirapur Works, P.O. Burnpur.
- *Singh, T. C. N.**, D.Sc., F.B.S., Prof. & Head of the Dept. of Botany, Annamalai University, Annamalai Nagar
- Singh, (Dr.) U.N.**, 7A, Tagore Town, Allahabad-2.
- Singhi, Narendra Singh**, M.Sc., B.L., M.L.A., Singhi Park, Ballygunge, Calcutta-19.
- Singha, (Mrs.) A.**, B.A., M.Ed., 15/1, Ramkanto Bose Street, Calcutta-3.
- Sinha, A. K. P.**, M.A., M.Sc., Ph.D., Dept. of Psychology, Patna College, Patna-5.
- Sinha, A. S.**, M.D., Ph.D., Dept. of Physiology, P. W. Medical College, Patna.
- Sinha, Arun Kumar**, M.Sc., 16, Sastitala Road, Calcutta-11.
- Sinha, C. M.**, C/o. The Scientific Instrument Co., Ltd., 6, Tej Bahadur Sapru Road, Allahabad.
- Sinha, Deb Kumar**, 16, Sastitala Road, Calcutta-11.
- Sinha, Durganand**, Head of the Dept. of Applied Psychology & Offg. Director of the Institute of Psychological Research & Service, Patna University, Patna.
- Sinha, Harish Chandra**, M.A., Ph.D., F.S.S., Dept. of Economics, Calcutta University, Calcutta.
- Sinha, M. S.**, D.Sc., Dept. of Physics, Bose Institute, 93, Upper Circular Road, Calcutta.
- Sinha, N. C.**, Chartered Engineer, B.M.S., Kola Villa, 23/37, Gariahat Road, Calcutta-19.
- Sinha, R. P.**, B.Sc., Ph.D., Principal, School of Mines & Applied Geology, Dhanbad.
- Sinha, Sri Rama**, Mathematics Dept., Allahabad University, Allahabad.
- Sinha, (Mrs.) S.**, C/o. Shri S. R. Sinha, 784, University Road, Allahabad.
- Sinha, S. C.**, M.Sc., Ph.D., Psychology Dept., University College of Science, 92, Upper Circular Road, Calcutta.
- Sinha, S. N.**, M.A., F.I.C., Councillor, Calcutta Corporation, Chairman, Emblem Committee, 16, Sastitala Road, Calcutta-11.
- Sinha, Tarun Chandra**, M.Sc., Psycho analyst, Supdt., Lumturi Park (Mental Hospital), 67, Jatindas Road, Calcutta-29.
- Sinha, Tarun Kumar**, 16, Sastitala Road, Calcutta-11.
- Sinha, Tribeni Prasad**, M.B., B.S.M.S (Penu), U.S.A., Prof. of Anatomy, Patna Medical College, Patna-4.

- Sinha, T. N.**, Asst. Manager, Messrs. A. H. Wheeler & Co., 18, Netaji Subhas Road, Calcutta-1.
- Sinha, (Sm.) Uma**, Lecturer, Women's Training College, Patna.
- Sircar, (Mrs.) Chinmoyee**, 98, Christopher Road, Calcutta-14.
- Sircar, J. P., M.B.**, Bose Research Institute, 93, Upper Circular Road, Calcutta.
- Sircar, Prabhati Kumar**, C/o. Geography Dept., The University, Senate House, Calcutta-12.
- Sirkar, S. C., D.Sc., F.N.I.**, Prof. of Physics, Indian Association for the Cultivation of Science, Calcutta-32.
- Sircar, S. K., M.Sc., Ph.D., A.R.S.M., D.I.C.**, Chemical Engineer, C/o. Bararee Coke Works, P.O. Kasunda, Manbhum.
- Sircar, (Dr.) S. M.**, Dept. of Botany, University College of Science, 35, Ballygunge Circular Road, Calcutta.
- Sirsi, (Dr.) M.**, Asst. Prof. of Pharmacology, Indian Institute of Science, Bangalore 3.
- Sitaraman, M. V., M.A., A.R.I.C.**, 24, Deivasigamani Mudali Street, Royapettah, Madras.
- Sitholey, R. V.**, Asst. Director, Birbal Sahni Institute of Palaeobotany, 53, University Road, Lucknow.
- Sivaraman, A.**, In-charge, Scientific Dept., Martine & Harris Co., Ltd., Savoy Chamber, Wallace Street, Bombay-1.
- Sivasambhan, M. A., M.Sc.**, Central Laboratories for Scientific & Industrial Research, Hyderabad-Dn.
- Sohonie, (Mrs.) Kamala, M.Sc., Ph.D.**, Amarchandra Mansion, Mayo Road, Bombay.
- Solomon, (Dr.) S.**, Plant Physiologist, Govt. Farm, Dharwar.
- Soman, (Dr.) S. W.**, Asst. Director, Haffkine Institute, Parel, Bombay-12.
- Sondhi, Ved Pall, M.B.E., M.Sc., F.G.S.**, Geological Survey of India, 27, Chowringhee, Calcutta.
- Soparkar, K. M., Capt., M.D., F.C.P.S., A.M.S.**, Military Hospital, Poona-1.
- Sopory, S. N.**, Manager, Cement Marketing Co. of India Ltd., Bombay Mutual Building, Royal Exchange Place, Calcutta.
- Soundara Rajan, K. V., M.A.**, Asst. Supdt., Dept. of Archaeology, North Western Circle, Safdarjung Gate House, New Delhi.
- Sreenivasiah, B. N., M.Sc., F.A.Sc.**, Director, Aviation Services, India Meteorological Dept., Lodi Road, New Delhi.
- Sreenivasaya, M.**, 17th Cross, Malleswaram P.O., Bangalore-3.
- Srinivas, Mysore N., B.A., M.A., LL.B., Ph.D., D.Phil., M.A.**, Prof. of Sociology, M. S. University, Faculty of Science, Baroda.
- Srinivas, T. V.**, Teacher, Faculty of Education & Psychology, M. S. University, Baroda.
- Sreenivasan, A., D.Sc., F.R.I.C.**, Dept. of Chemical Technology, University of Bombay, Bombay-19.
- Srinivasan, A. K.**, Train Examiner, Kazipeth Rly. Junction, Hyderabad State, Deccan.
- Sreenivasan, P. S.**, Asst. Meteorologist (Statistics), Meteorological Office, Poona-5.
- Srinivasan, R., B.Sc.**, Hydrologist, Madras Govt. Fisheries, Fresh Water Biological Research Station, 95, Poonamallee High Road, Kilpauk, Madras-10.
- Srinivasan, V. V.**, Indian Veterinary Research Institute, Mukteswar Kuman.
- Srivastava, B. N., D.Sc., F.N.I.**, Prof. of General Physics, Indian Association for the Cultivation of Science, Jadavpur, Calcutta-32.
- Srivastava, C. M.**, Dept. of Geology, Ranchi College, Ranchi.
- Shrivastava, (Dr.) D. L.**, Asst. Director, Central Drug Research Institute, Chatter Manzil Palace, Lucknow.

- Srivastava, H. D.**, M.Sc., D.Sc., Helminthologist, Indian Veterinary Research Institute, Izatnagar.
- Srivastava, J. G.**, Science College, Patna
- Srivastava, K. R.**, Deputy Director of Marine Products, Jamnagar, Sourashtra.
- Srivastava, L. N.**, M.Sc., Lecturer in Chemistry, Lucknow University, Lucknow.
- Srivastava, M. G.**, Research Scholar, Botany Dept., Bose Research Institute, 93/1, Upper Circular Road, Calcutta.
- Srivastava, (Sm.) Pramila**, Allahabad.
- Srivastava, S. P.**, Gupta Bhavan, Maharaj Nagar, Lakhimpore, Kheri.
- Standard Vacuum Oil Co. Ltd.**, 6, Church Lane, Calcutta-1.
- Subramanian, M. K.**, M.A., D.Sc., F.A.Sc., Lecturer in Cytogenetics, Indian Institute of Science, Bangalore-3
- Subramanian, C. V.**, M.A., Ph.D., Reader in Botany, University Botany Laboratory, Madras-5.
- Subramnian, (Dr.) T. S.**, Superintendent, Development Laboratory, Post Box 127, Kanpur.
- Subrahmanyam, V.**, D.Sc., F.I.C., F.N.I., Director, Central Food Technological Research Institute, Cheluvamba Mansions, V. V. Mohalla P.O., Mysore.
- Superintendent of Development**, Military Explosives, Kirkee, Poona-3.
- Sur, M. M.**, Sur Enamel & Stamping Works Ltd., 24, Middle Road, Calcutta-14.
- Suratkar, Tulsidas Shankar**, M.Sc., Prof. & Head of the Chemistry Dept., N. T. College, Bombay.
- *Swami, Purushottama Dasa**, M.Sc., F.I.C.S., F.G.M.S., M.S., Enamel Technologist, Tej Enamel & Metal Works, Gangoh Road, Saharanpur, U.P.
- Swarup, D.**, Ph.D., A.I.C., M.I.M., M.I. & S.I., M.M.G.I., Principal, College of Mining & Metallurgy, Banaras Hindu University, Banaras
- † Swarup, Shanti**, M.A., C/o. The Post Master, G.P.O., New Delhi.
- Syam Chowdhuri, N. K.**, M.A., Asst. Anthropologist, Dept. of Anthropology, Sub Station, Port Blair, Andaman Island.

T

- Taimuri (Dr.) M. H. R.**, Director of Archaeology, Moti-Mahal, Bhopal.
- Talati, Ambalal M.**, Lecturer in Chemistry, Petlad College, Petlad (Via Anand).
- Talekar, V. K.**, Prof. of Physics, Maharaja's College, Jaipur.
- Talwalkar, Trymbak Waman**, M.S., Univ. of Illinois, Ceramist, Tata Iron & Steel Co., Ltd., 8, Bagmati Road, Jamshedpur.
- Tamhane, R. V.**, Ph.D., Soil Survey Officer, Indian Agricultural Research Institute, New Delhi.
- Tandon, (Dr.) R. K.**, Director, Sugarcane Research, Shahjahanpur.
- Tandon, (Dr.) R. N.**, Reader in Botany, University of Allahabad.
- Tangree, Hosang K.**, Messrs. Hoshang Tangree & Co., 32, Ezra Street, Calcutta.
- Tangree, K. H.**, Messrs. Hoshang Tangree & Co., 32, Ezra Street, Calcutta.
- Tangree, Khursheed K.**, B.Com., Messrs. Hoshang Tangree & Co., 32, Ezra Street, Calcutta.
- *Tapadar, D. C.**, M.Sc., D.Phil., F.R.I.C., M.I.I.Chem.E., Chief Chemist, Indian Paper Pulp Co., P.O. Hazinagar, 24-Parganas.
- Tarktirtha, Kaviraj Bimalananda**, Bayakaran Tirtha, Shastri, Saraswati, Janashree, Ayurved Brihaspati, M.L.A., 90/3, Grey Street, Calcutta-5.
- Tata Oil Mills Co., Ltd.**, Tatapuram, Cochin State.
- Tawde, N. R.**, B.A., M.Sc., Ph.D., F.Inst., F.A.Sc., F.N.I., Prof. & Head, Physics Dept., Karnatak University, Dharwar.

- Tembe, V. B., Biology Dept., Elphinstone College, Bombay.
- Thacker, D. D., Dewan Bahadur, M.I.M.E., F.R.S.A., Honorary Magistrate (First Class), Colliery Owner, Pure Jheria Colliery, Jharia (Manbhum).
- Thacker, M. S., Director, Indian Institute of Science, Bangalore.
- Thakur, (Dr.) B., Chemistry Deptt., Patna University, Patna.
- Thakur, Ram Sinha, D.Sc., Ph.D., M.Sc., Deputy Chief Scientific Officer (Army), Ministry of Defence, New Delhi.
- Thakor, K. K., Senior Lecturer in Electrical Engg., Palace Road, Baroda.
- *Thakor, V. M., M.Sc., Ph.D., Research Asst. in Organic Chemistry, The Institute of Science, Mayo Road, Fort, Bombay.
- Thapar, G. S., M.Sc., Ph.D., F.N.I., F.A.Sc., F.G.I., Prof. & Head of the Dept. of Zoology, Lucknow University, Lucknow.
- Thausu, Kider Nath, M.A., LL.B., Enthnological Asst., Dept. of Anthropology, Indian Museum, 27, Chowringhee, Calcutta.
- Thawani, (Prof.) V. D., University Colony, Gauhati, Assam.
- Travancore Rayons Ltd., The, Rayonpuram P.O., N. Travancore.
- Treasurer, C. N., Junior Lecturer in Textile Engineering Dept., Faculty of Technology, Baroda.
- Trivedi, Ashwin M., M.Sc., Ph.D., Prof. of Chemistry, L. D. Arts College & M. G. Science Institute, Ahmedabad-9.
- Trivedi, G. K., M.Sc., B.T., Demonstrator in Physics, Baroda College, Baroda.
- Trivedi, Harbhai, President, Home School, Bhavnagar.
- Trivedi, Kunjbihar N., Chemistry Dept., Faculty of Science, M. S. University, Baroda.
- Toshniwal, B. D., M.Sc., S.M. (M.I.T.), Assoc Mem.I.R.E., C/o. Toshniwal Bros. Ltd., 198, Jamshedji Tata Road, Churchgate Reclamation, Fort, Bombay-1.
- Toshniwal, G. R., D.Sc., S.M.I.R.E., F.N.I., C/o. Toshniwal & Bros. Ltd., 198, Jamshedji Tata Road, Churchgate Reclamation, Fort, Bombay-1.
- Tuteja, D. R., Proprietor, Scientific Glass Works, 2539, Bengali Mahalla, Amballa Cantt.
- Tiagi, B. D., Head of the Botany Dept., Govt. College, Ajmer
- *Tilak, B. D., B.Sc., Ph.D., D.Phil., Prof. of Dycotuff Technology, Dept. of Chemical Technology, University of Bombay, Matunga, Bombay.
- Tiwary, N. K., M.Sc., 13D, Proyag Street, Allahabad.
- Tiwari, N. M. (Dr.), Lecturer in Pharmacology, Nagpur Medical College, Nagpur.
- Tiwari, (Dr.) R. D., Dept. of Chemistry, University of Allahabad.
- Tiwari, Shiva Shanker, M.Sc., Ph.D., Lecturer in Chemistry, Lucknow University, Lucknow.
- Tummin-Katti, M. C., M.Sc., Ph.D., A.R.I.C., Chief Chemist & Proprietor, Karnatak Chemical Works, 5/17, Reddy Colony, Dharwar,

U

- *Ukil, A. C., M.B., M.S.P.E. (Paris), F.S.M.B., F.N.I., Formerly Principal, Calcutta Medical College, 67, Dharmatalla Street, Calcutta-13.
- Under Secretary, Ministry of Food & Agriculture (Food), Jamnagar House, Man Singh Road, New Delhi.
- UNESCO Science Co-operative Office for South Asia, C. S. I. R. Building, Old Mill Road, New Delhi.
- *Union Drug Co. Ltd., 285, Bowbazar Street, Calcutta.
- Unny, K. Lakshmi, Demonstrator in Zoology, Faculty of Science, M. S. University, Baroda.

V

- Vachhani, (Dr.) Moti V.**, Agronomist, Central Rice Research Institute, Cuttack (Orissa).
- ***Vad, B. G.**, M.D., Consulting Physician, Peerbhoy Mansions, Sandhurst Road, Girgaun, Bombay-4.
- Vaheeduddin, Sayed**, M.Sc., Ph.D., Plant Pathologist to the Government, Main Agriculture Farm, Himayatsagar, Hyderabad-Deccan.
- Vaidya, L. S.**, Lecturer, Dept. of Chemical Technology, Osmania University, Jami-Osmani P.O., Hyderabad-Deccan
- Vaidya, P. C.**, P/9, Vallabh Vidyanagar, Via Anand.
- Vaidya, (Dr.) W. M.**, Asstt. Director, National Physical Laboratory, New Delhi-12.
- Varma, D. M.**, M.Sc., D.Phil., Zoology Department, The University, 27, George Town, Allahabad.
- Varman, I. S.**, B.Sc., A.M.T.I. (Lond.), M.A.E., A.M.I.P.E. (Lond.), Mechanical and Electrical Engineer, 86, Ramanath Dass Road, Dhakuria P.O., Calcutta-31.
- Vashi, Dinkar Ghelabhai**, Lecturer in Statistics, Baroda University, Baroda.
- Vasudeva, R. S.**, D.Sc. (Lond.), Ph.D. (Lond.), D.I.C., F.N.I., Head of the Division of Microbiology & Plant Pathology, Agriculture Research Institute, Bunglow No. 14, New Delhi.
- Venkatesachar, B.**, Rao Bahadur, M.A., Professor of Physics, Vijaya College, Bangalore-4.
- Venkatachary, S.**, Professor of Botany, M. B. College, Udaipur.
- Venkatachari, V. P.**, M.A., Ph.D., D.I.C., Professor & Head of the Dept. of Mathematics, Osmania University, Hyderabad-Dn.
- ***Venkateswaran, C. S.**, Principal, University College, Trivandrum.
- Venkataraman, D.**, 4/5, D'Silva Road, Mylapore, Madras.
- Venkataraman, K.**, A.M.I.Chem.E., D.Sc., Director, Department of Chemical Technology, University of Bombay, Matunga, Bombay-19.
- Venkataraman, R.**, Superintendent, Fisheries Technological Station, Koihekodde-1.
- Venkataraman, (Sir) T. S.**, Kt., C.I.E., D.Sc., Rao Bahadur, 56, Thyagaraja Road, T. Nagar, Madras-17.
- Venkateshwaran, S. P.**, Meteorologist-in-charge, Instruments & Supplies, Meteorological Office, Poona-5.
- Venkataswarlu, J.**, D.Sc., Ph.D., Professor & Head of the Department of Botany, Andhra University, Waltair.
- ***Vesugar, J.**, 11, Safdarjang Road, New Delhi.
- Verma, Bind Behari**, M.Sc., Research Scholar, University of Delhi, P.O. & Vill Hulesra, Via Vasantpur, Saran.
- Verma, G. S.**, M.Sc., Ph.D., F.L.S. (Lond.), F.R.H.S., Lecturer in Botany, University of Lucknow, Lucknow.
- Verma, Gyanendra**, M.Sc., Vivekananda Laboratory, Almora.
- Verma, H. C.**, Associated Instrument Manufacturing (India) Ltd., B-5, Clive Buildings, Post Box No. 2136, Calcutta.
- Verma, Harish Chandra**, M.B.B.S., Reader in Anatomy, King George's Medical College, Lucknow.
- Verma, K. P.**, M.Sc., Senior Lecturer in Physics, Faculty of Science, M. S. University, Baroda.
- Verma, Raghuji**, M.Sc., F.G.M.S., Department of Geology, Ranchi College, Ranchi.
- Visva Bharati**, Santiniketan, Birbhum.
- Viswanath, (Dr.)** Professor & Head of the Department of Zoology, Panjab University, Hoshiarpur.
- Viswanath, (Mrs.) C/o. Dr. Viswanath**, Head of the Department of Zoology, Panjab University College, Hoshiarpur.

Viswanath, S. N., 3, Harbour Park, Waltair.

Viswanathan, (Dr.) D. K., Director, Public Health, Poona.

Viswanathan, P. S., Rao Sahib, Agricultural Engineer to the Govt. of U. P.,
Agricultural Gardens, Nawabganj, Kanpur.

Vazirani, T. G., Entomological Asstt., Zoological Survey of India, 34, Chittaranjan Avenue, Calcutta.

W

Wadia, D. N., M.A., D.Sc., F.G.S., F.N.I., Geological Adviser, Atomic Energy Commission, Govt. of India, 10, King George's Avenue, New Delhi.

Wadia, (Mrs.) Meher D. N., B.A., B.T. (Bombay), C/o. Dr. D. N. Wadia, Geological Adviser, Atomic Energy Commission, 10, King George's Avenue, New Delhi.

Wagh, Ramesh Vishnu, M.Sc., Lecturer in Applied Physics, Engineering College, Poona-5.

Wakhaloo, S. N., M.Sc., Ph.D., F.G.S., Head of the Dept. of Geology, Science College, Mohendru P.O., Patna-6.

Walchandnagar Industries Ltd., Walchandnagar, Poona.

Walvalkar, B. R., C/o. Tata Chemicals Ltd., Mithapur, Okhamandal, W. Railway

Warty, S. S., Junior Lecturer in Textile Chemistry, Kala Bhavan, Baroda.

Watcha, Fredoom S., Mining Engineer, Agent, Tata's Sijua Group of Collieries, Jamadoba, Jealgora P.O., Manbhum.

Western Electric & Scientific Works, Nicholson Road, near Nigar Talkies, Ambala Cantt.

World Press Ltd., The, Book Service Division, 37, College Street, Calcutta-12

Y

Yadav, Haribansh Narayan, M.Sc., Ph.D., Asst. Professor of Physics, Patna University, Patna-5.

Yajnik, N. A., M.A., D.Sc., A.R.I.C., F.N.I., Principal, P. M. B. Gujrat College, Indore (M.B.)

Yeddanapalli, Rev. Lourdu, S.J., Ph.D. (Princeton), D.Sc. (Louvain), M.A., Head of the Dept. of Chemistry, Loyola College, Cathedral, Madras.

Yunus, Mohd., M.A., Ph.D., LL.D., F.R.G.S., Professor of Geography, Govt. Degree College, Nainital.

Z

Zaheer, (Dr.) S. H., Director, Central Laboratories, Jama-i-Osmania P.O., Hyderabad-Deccan.

Zaidi, Raza Husain, M.Sc., Lecturer, Department of Geography, Muslim University, Aligarh.

Zoological Survey of India, 34, Chittaranjan Avenue, Calcutta-12.

MEMBERS WITHOUT VOTING RIGHT, ENROLLED AT CALCUTTA

A

- Adhya**, (Miss) Dipti, B.Sc., C/o. Mr. G. M. Adhya, Bowreah Cotton Mills Co. Ltd., Bauria.
- Adhya**, G. M., B.Sc., B.E. (Wis. U.S.A.), Grad. G. E. Tech. (Mass), A.M.A.E., M.I.S.C., Bowreah Cotton Mills Co. Ltd., Mawriah.
- Adhya**, (Mrs.) Jotirmoyee, C/o. Mr. G. M. Adhya, Bawreah Cotton Mill Co. Ltd., Bauria.
- Agarwal**, Kamal Krishna, M.Sc., 6, Shibu Thakur Lane, Barabazar, Calcutta.
- Agarwal**, R. S., Managing Director, Scientific Instrument Co. Ltd., 6, Tej Bahadur Sapru Road, Allahabad-1.
- Aiyar**, S. Narayana, Lecturer Science College, Raipur.
- Anjaneyulu**, (Dr.) J. V. S. R., Senior Scientific Officer, Central Salt Research Institute, Bhavnagar.
- Ansari**, (Dr.) Anwar, Lecturer in Psychology, Muslim University, Aligarh.
- Ansari**, (Mrs.) Ghazala, Lecturer in Education, Muslim University, Aligarh.
- Apte**, L. M., C/o. Prof. G. B. Kolhatkar, 759/88, Shivajinagar, Poona-1.

B

- Bagchi**, (Dr.) S. N., C/o. Dr. S. N. Bose, Khaira Professor of Physics, University College of Science, Calcutta-9.
- Bai**, (Sm) A. R. Kasturi, Dept. of Zoology, Central College, Bangalore.
- Bakshi**, Som Prakash, M.Sc., Lecturer in Chemistry, A. S. College, Srinagar.
- Bakshi**, Subhendu Kumar, M.Sc., 5, Satyen Dutta Road (first floor), Calcutta-29.
- Balu**, V., Division of Information & Statistics, Central Food Technological Research Institute, V. V. Mohalla, Mysore.
- Banerjee**, B. K., Councillor, Calcutta Corporation, 5, Surendra Nath Banerjee Road, Calcutta.
- Banerjee**, (Mrs.) B. K., C/o. Sri B. K. Banerjee, Councillor, Calcutta Corporation, 5, Surendra Nath Banerjee Road, Calcutta.
- Banerjee**, S. R., 59/B, Lansdowne Road, Calcutta-25.
- Bappu**, (Dr.) M. K. Vainu, Chief Astronomer, Govt. Astronomical Observatory, Banaras-2.
- Barua**, Arun Kumar, 49/1, Baldeopara Road, Calcutta-6.
- Basu**, D., Ph.D., Dept. of Theoretical Physics, Indian Association for the Cultivation of Science, Jadavpur, Calcutta-32.
- Basu**, Debabrata, M.A., A.I.I.S.I., Indian Statistical Institute, 204, Barrackpore Trunk Road, Calcutta-35.
- Basu**, Deb Kumar, M.B., D.T.M., 27A, Boloram Ghosh Street, Calcutta-4.
- Basu**, (Sm.) Kalyani, P556, Block 'N', New Alipore, Calcutta-33.
- Basu**, Prabhas Kumar, M.Sc., Mycological Research Assistant, State Agriculture Research Institute, Calcutta-40.
- Basu**, Rabindra Kumar, Technological Research Laboratory, Indian Central Jute Committee, Moore Avenue, Tollygunge, Calcutta-40.
- Batra**, (Dr. Mrs.) Shanti, Head of the Department of Botany and Biology, Lady Brabourne College, Calcutta.
- Bhaduri**, S. N., M.Sc., Ph.D., Asstt. Professor of Botany, Presidency College, Calcutta.
- Bharucha**, (Dr.) F. R., Director, The Institute of Science, Mayo Road, Fort, Bombay.
- Bhatt**, D. M., H. S. Rampuria Vidya Niketan, Ganga Sahar, Bikaner.

- Bhattacharyya**, Amal Chandra, B.Sc., Ph.C. (Lond.), M.P.S., Plot No. 700H, 'P' Block, New Alipore, Calcutta-33.
- Bhattacharya**, Asutosh, Dept. of Anthropology, Indian Museum, 27, Chowringhee, Calcutta-13.
- Bhattachari**, E. P. M., M.Sc., Department of Biochemistry, Nagpur University, Nagpur.
- Bhowmik**, (Miss) Gouri, 7, Sirdar Shankar Road, Calcutta-26.
- Bhowmik**, (Mrs.) Sarama, 7, Sirdar Shankar Road, Calcutta-26.
- Bir**, Sarmukh Singh, 25, Patiala Hostel, Khalsa College, Amritsar.
- Bose**, Debabrata, 93/1, Upper Circular Road, Calcutta-9.
- Bose**, (Prof.) H. N., Dept. of Physics, Indian Institute of Technology, Kharagpore.
- Bose**, (Sm.) Monisha, D.Phil., Dept. of Chemistry, University College of Science, 92, Upper Circular Road, Calcutta-9.
- Bose**, Nolini Kanto, Director, River Research Institute, West Bengal, Anderson House, Alipore, Calcutta-37.
- Bose**, (Mrs.) Renuka, C/o. Dr. Anadi Bose, 29A, Vivekananda Road, Calcutta-7.
- Bose**, Saroj Kumar, M.Sc., Professor of Chemistry, City College, Calcutta-29.
- Braganca**, (Dr. Miss) Beatriz M., M.Sc., Ph.D. (Canada), Biochemistry Research Officer, Indian Cancer Research Centre, Parel, Bombay.
- Brahmachari** (Mrs.) Goparani, 19, Loudon Street, Calcutta-16.
- Bysack**, Krishna Chandra, Councillor, Corporation of Calcutta, 14-3, Sovaram Bysack Street, Calcutta-7.

C

- Cama**, (Dr.) H. R., Assistant Professor, Department of Biochemistry, Indian Institute of Science, Bangalore-3.
- Central Inland Fisheries Research Institute**, Old Mint Building, 47/1, Stand Road, Calcutta-7.
- Chanbal**, (Miss) Puspallata D., C/o. Shri N. L. Shah, Zoology Department, N. Wadia College, Poona.
- Chanda**, K. C., Department of Statistics, Bombay University, Bombay.
- Chandiramani**, (Miss) P. V., Manager, Womens Rehabilitation Department, Hornby Road, Fort, Bombay.
- Chandiramani**, (Miss) S. V., Division of Botany & Nutrition, Central Food Technological Research Institute, V. V. Mohalla, Mysore.
- Chakravarty**, H. L., D.Sc. (Edin.), F.L.S., F.B.S., Head of the Department of Botany, Presidency College, Calcutta.
- Chakravarti**, M.D., B.Sc., M.B., D.Phil (Oxon.), Director, Central Drugs Laboratory, Government of India, 3 Kyd Street, Calcutta-16.
- Chakravarti**, Manish Ranjan, Lecturer in Anthropology, Bangabasi College, 25/1, Scott Lane, Calcutta-9.
- Chakravarti**, S. C., Scientific Instrument Co. Ltd., 30, Mount Road, Madras-2.
- Chakravarti**, S. N., C/o. Dr. S. K. Mukherjee, Applied Chemistry Department, University College of Science, Calcutta-9.
- Chatterjee**, (Dr.) A., Technological Research Laboratory, Indian Council of Jute Committee, 12, Regent Park, Tollygunge, Calcutta-40.
- Chatterjee**, A., Lecturer, Vidyasagar College, 39 Shankar Ghosh Lane, Calcutta.
- Chatterjee**, (Dr. Mrs.) Anjali, 21, Waverley Mansions, 72/4, S. N. Banerjee Road, Calcutta-14.
- Chatterjee**, (Dr.) Anupam, Bengal Veterinary College, Belgachia, Calcutta.
- Chatterjee**, Biswanath, Communicating Engineering Department, Indian Institute of Technology, Kharagpore.
- Chatterjee**, (Dr.) K. R., Leprosy Engineering Department, School of Tropical Medicine, Chittaranjan Avenue, Calcutta.

- Chatterjee, Kanti Pada**, Department of Physiology, Presidency College, Calcutta.
Chatterjee, Ram Govinda, Department of Psychology, University College of Science, 92, Upper Circular Road, Calcutta-9.
Chatterji, Salil Kumar, Lecturer, Government College, Darjeeling.
Chatterjee, Tarapada, Lecturer in Zoology, City College, Calcutta-9.
Choudhuri, (Miss) Anubha, C/o. Dr. J. K. Choudhury, P286, Darga Road, (Suite No. 5), Park Circus, Calcutta-17.
Consul, (Dr.) B. N., Department of Pharmacology, S. M. S. Medical College, Jaipur.
Chaudhuri, A. C., B.Sc., Ph.D. (Edin.), Professor of Animal Husbandry and Vice-Principal, Bengal Veterinary College, Belgachia, Calcutta.
Chowdhury, Ajit Kumar, Asstt. Professor of Pharmacology, Bengal Veterinary College, Belgachia, Calcutta-39.
Choudhury, Niren, Department of Anthropology, Indian Museum, 27, Chowringhee, Calcutta-13.
Chaudhuri, S. B., M.Sc., Head of the Department of Statistics, Asutosh College, 9, Russa Road, Calcutta-26.
Chowdhury, Subodh Bikash, Department of Physiology & Nutrition, Bengal Veterinary College, Belgachia, Calcutta-39.
Chaudhuri, Subodh Govinda, D.Sc., Lecturer in Physical Chemistry, University College of Science, 92, Upper Circular Road, Calcutta-9.
Chowdhury, (Miss) Uma, D.Phil, Department of Anthropology, Indian Museum, 27, Chowringhee, Calcutta-13.

D

- Dabholkar, (Prof.) V. D.**, Wilson College, Bombay-7.
Dale, A., C/o. Scientific Instrument Co. Ltd., 11, Esplanade East, Calcutta.
Dandiya, P. C., Department of Pharmacology, S. M. S. Medical College, Jaipur.
Das, Bhagwan, Research Scholar, Geology Department, Indian Institute of Technology, Kharagpore.
Das, (Dr.) Bimal Chandra, 17A, Ekdalia Place, Calcutta-19.
Das, Nanda Kisore, Department of Physiology & Nutrition, Bengal Veterinary College, Belgachia, Calcutta-37.
Das, Nikhilendu, 4/2, Ekdalia Road, Calcutta-19.
Das, (Dr.) P. K., Department of Pharmacology, S. M. S. Medical College, Jaipur.
Das, (Dr.) S. M., Department of Zoology, The University, Lucknow.
Das Gupta, B., M.Sc., Research Fellow, Department of Pharmacology, School of Tropical Medicine, Chittaranjan Avenue, Calcutta.
Das Gupta, (Mrs.) Kanak Beena, M.R.C.O.G., etc., 18, Deshapriya Park Road, Calcutta-26.
Das Gupta, Nishi Kanta, M.Sc., Professor of Physics, Bangabasi College, 19, Scott Lane, Calcutta.
Das Gupta, (Dr.) P. C., Technological Research Laboratory, Indian Central Jute Committee, 12, Regent Park, Tollygunge, Calcutta-40
Das Gupta, (Prof.) S. N., Department of Botany, Lucknow University, Lucknow.
Das Gupta, S. P., 372/68, Russa Road, (South), Tollygunge, Calcutta-33.
Das Gupta, S. R., M.B.B.S., Provincial Drug Control Laboratory, West Bengal, 18, Deshapriya Park Road, Calcutta-26.
Deka, (Miss) Usha, M.Sc., C/o. Justice H. Deka, Bharalumukh, Gauhati.
Desai, K. V., Principal, R. R. Lanan College, BhujCutch.
Desai, S. D., M.Sc., Lecturer in Geology, Banaras Hindu University, Banaras.
Devi, (Miss) H. Maheswari, Department of Botany, Andhra University, Waltair, Visakhapatnam-3.

- Dey**, Shyam Chand, 11, Balak Dutt Lane, Calcutta-7.
- Dhawan**, C. L., Division of Botany, Indian Agricultural Research Institute, New Delhi.
- Dixit**, K. K., C/o. Shri V. T. Chiplonkar, 253/6, Sadashiv Peth, Poona-2.
- Dubey**, Gyam Prakash, 24, Mall Road, Near Power House, Morar, Gwalior.
- Dutta**, Birendra Nath, M.Sc., Chemist, Biochemistry Department, School of Tropical Medicine, Chittaranjan Avenue, Calcutta.
- Dutt**, (Miss) Gitarani, C/o. Kaviraj Atul Behari Dutt, 29A, Vivekananda Road, Calcutta-7.
- Datta**, P. C., Botany Department, University College of Science, 35, Ballygunge Circular Road, Calcutta-19.
- Dutt**, Pratap Chandra, M.Sc., 1-B, Gopal Bose Lane, Calcutta-9.
- Dutta**, Provas Kumar, M.Sc., 10, Grand Trunk Road, Bhadrakali-P.O., Hooghly.
- Dutt**, S. C., M.Sc., Assistant Research Officer, Division of Parasitology, Indian Veterinary Research Institute, Izatnagar.
- Dutt**, (Sm.) Snehadata, C/o. Kaviraj Atul Behari Dutt, 29A, Vivekananda Road, Calcutta-7.
- Dutt**, Sunil Bhusan, C/o. Kaviraj Atul Behari Dutta, 29A, Vivekananda Road, Calcutta-7.
- Dubey**, V. S., M.Sc., Ph.D., D.I.C., Professor of Economic Geology, Banaras Hindu University, Banaras.

F

- Faruqi**, (Dr.) J. A., Fisheries Biologist to the Government of U.P., 28, Outram Road, Lucknow.

G

- Ganpule**, Narayan Bishnu, M.Sc., B.Sc. Tech, Documentation Officer, National Physical Laboratory, New Delhi-12.
- Ghanekar**, (Miss) D. S., Lokamanya Nagar, Mahim, Bombay-16.
- Ghose**, Apurba Kumar, M.Sc., Botanical Laboratory, Indian Institute of Technology, Kharagpore.
- Ghosh**, Amrita Renu, Department of Chemistry, Indian Institute of Technology, Kharagpore.
- Ghosh**, Bhabani Ch., M.Sc., M.B., 116, Vivekananda Road, Calcutta-6.
- Ghosh**, (Dr.) Bimalendu, Assistant Professor of Chemical Engineering, Jadavpur College, Calcutta-32.
- Ghosh**, (Dr.) M. N., Lecturer, Department of Statistics, University of Calcutta, Asutosh Building, Calcutta.
- Ghose**, Sachindra Prosad, M.A., D.Phil, Councillor, Central Bureau of Education & Vocational Guidance, 33, Probyn Road, Delhi.
- Ghosh**, Saroj Bandhu, Microbiology Section, Bose Institute, 93/1, Upper Circular Road, Calcutta-9.
- Ghosh**, Sisir Comar, M.Sc., 63/1, Mahanirvan Road, Calcutta-29.
- Ghosh Majumdar**, Ashutosh, M.Sc., Statistical Assistant, Farm Management Enquiry, Economic Research Section, Indian Central Jute Committee 11-A, Bhabanath Sen Street, Calcutta-4.
- Ghosh Majumdar**, S., 13, Hem Kar Lane, Calcutta-5.
- Godbole**, N. K., M.A., B.Sc., Ph.D., "Udyog", Purandare Colony, Poona-2.
- Gopalakrishna**, A., Lecturer, College of Science, Nagpur.
- Gopalswamy**, S. N., Technical Officer, Ministry of Home Affairs, 20A/32, Lodi Road, New Delhi.

- Gopalaswamy, (Mrs.) S. N.**, C/o. Dr. S. N. Gopalaswamy, Technical Officer, Ministry of Home Affairs, 20A/32, Lodi Road, New Delhi.
- Gosling, G. W.**, C/o. Martin & Harris Ltd., Savoy Chambers, Wallace Street, Bombay-1.
- Goswami, A.**, 44, Rai A. C. Banerjee Bahadur Road, Bally-P.O., Howrah.
- Goswami, P. C.**, Cotton Cottage, Gauhati.
- Guha, M. L.**, Manager, Adair, Dutt & Co. (India) Ltd., Calcutta National Bank Buildings, Sir Phirozeshah Mehta Road, Bombay.
- Gupta, G. N.**, Research Chemist, H. B. Technological Institute, Kanpur.
- Gupta, S. L.**, Research Assistant, Indian Institute of Sugar Technology, Kanpur.

H

- Hajra, Bansidhar**, 3/2, A. K. Roy Choudhury Lane, Sibpore, Howrah.
- Harper, E. Edwin, Jr.**, M.A., Ph.D., Indian Statistical Institute, 203, Barrackpore Trunk Road, Calcutta-35.
- Hingorani, (Dr.) M. K.**, Assistant Plant Bacteriologist, Division of Mycology, Indian Agriculture Research Institute, New Delhi-12.
- Hore, Pramatha Nath**, M.Sc., Lecturer in Geography, Presidency College, Calcutta.

I

- Iyer, (Prof.) V. G.**, F.R.I.C., M.Inst.F., Ag. Head of the Department of Fuel Technology College of Mining & Metallurgy, Hindu University, Banaras.
- Iyengar, K. S.**, M.Sc., Dip.Ed., Ph.D., Lecturer in Physics, Osmania University, Hyderabad-Deccan.

J

- Jahan, Iftakhar**, M.B., M.S. (U.S.A.), Asstt. Professor of Physiology, Assam Medical College, Dibrugarh.
- Jogarao, A.**, D.Sc., Assistant Director, Central Electrochemical Research Institute, Alagappa College-P.O., Karaikudi.
- John, C. C.**, Manager, Adair, Dutt & Co. (India) Ltd., Mount Road, Madras-2.

K

- Kalbag, V. S.**, 36, Hanuman Road, Vile Parle (East), Bombay-24.
- Kar, Prithwish**, Assistant Field Officer, Indian Bureau of Mines, P-21, Mission Row Extension, Calcutta-13.
- Kaul, (Prof.) K. N.**, Director, National Botanical Garden, Lucknow.
- Khan, Mohd. Naseer**, M.A., D.Phil, Reader Department of Geography, University of Allahabad, Allahabad.
- Khemka, Raj Kumar**, The Shankar Distillery & Chemical Works Ltd., 2, Doyhatta Street, Calcutta-7.
- Krishnamurthi, (Dr.) S.**, Professor & Head of the Department of Agriculture, Annamalai University, Annamalaiagar.
- Krishnan, (Dr.) V. R.**, Professor of Chemistry, D. A. V. College, Sholapur.
- Kumar, (Prof.) L. S. S.**, Principal, College of Agriculture, Poona-5.
- Kumar, Shiv**, M.Sc., M.B.B.S., P.O.M.S., Professor of Physiology, Medical College, Amritsar.

L

Lahiri, B. N., M.B., F.R.F.P.S., 128, Harrison Road, Calcutta.

Lahiri, Dinabandhu, 27, Maharaja Nandakumar Road (South), Baranagar, Calcutta-36.

Lahiri, Suhas Chandra, M.B.B.S., Physician, Clinical & Research Assistant in Medicine, Calcutta National Medical College, Chittaranjan Hospital, Calcutta.

Lal, Nand, General Manager, The Oriental Science Apparatus Workshop, 46, Jail Road, Indore City.

Lal, Surendra K., M.B.B.S., Department of Physiology, Medical College, Amritsar.

M

Mahalanobis, (Mrs.) Sova, B.A., B.T., 90, Park Street, Park Circus, Calcutta.

Mahapatra, G. N., Lecturer Dept. of Chemistry, Ravenshaw College, Cuttack-3.

Majumdar, Anil Kumar, Professor of Inorganic Chemistry, College of Engineering & Technology, Jadavpur, Calcutta-32.

Majumdar, S. K., B.Ag., M.Sc. (Ag.), Senior Scientific Assistant, Central Food Technological Research Institute, V. V. Mohalla-P.O., Mysore.

Mathew, A. P., M.A., Ph.D., Professor of Zoology, University College, Trivandrum (South India).

Mathur, S. B. L., M.Sc., D.Sc., Reader in Physics, Lucknow University, Lucknow.

Mehta, M. M., Ph.D., D.Litt, Director of Economic & Statistics, Directorate of Economic & Statistics, Sarafa Chamber (3rd floor), Mount Road, Nagpur.

Menon, A. A., Agricultural Engineer to the Government of Bombay State Agricultural Compound, Poona-5.

Menon, P. K. B., Birla College of Science, Pilani (Rajasthan).

Mitra, (Dr.) A. K., C/o. Dr. A. Chatterjee, Reader in Chemistry, University College of Science, 92 Upper Circular Road, Calcutta-9.

Mitra, Arun C., 18/51, Dover Lane, Calcutta-29.

Mitra, H. N., Senior Scientific Officer, Officer-in-charge, M.S.I.D., Hudson Lines, Dilkhusa, Lucknow.

Mitra, (Sm.) Sephalika, C/o. Dr. D. N. Mitra, C-32, Kharagpur Technology, Hijli.

Mitter, A. N., M.Sc., 6, Ballygunge Place, Calcutta-19.

Moos, (Mrs.) Homai Jal, Curzon House, Apollo Bunder, Bombay-1.

Moghe, (Miss) Sindhu, Birla College of Science, Pilani (Rajasthan).

Mounter, F. W., B.Sc. (Engg.), B.Sc. (U.S.A.), M.I.E.S. (U.S.A.), M.I.E.S. (Ind), Chief Engineer, Philips Electrical Co. (India) Ltd., 7, Justice Chandra Madhav Road, Calcutta-20.

Moza, B. K., B.Pharm., Bengal Immunity Research Institute, 39, Lower Circular Road, Calcutta-16.

Mukherjee, A. M., M.B., D.C.P. (Lond.), Asstt. Professor of Pathology, School of Tropical Medicine, Chittaranjan Avenue, Calcutta.

Mukherjee, Bhabananda, Assistant Anthropologist, Department of Anthropology, Indian Museum, 27, Chowringhee, Calcutta-13.

Mukherjee, Pratip Kumar, M.Sc., Lecturer in Geology, Bengal Engineering College, Botanic Garden-P.O., Howrah.

Mukherjee, (Mrs.) S. K., 157/1, Bokulbagan Road, Calcutta-25.

Munjal, Amritlal, The Oriental Science Apparatus Workshop, 46, Jail Road, Indore City.

Munshi, K. M., Principal, G. S. College of Science, Khamgaon-P.O., Buldena.

- Murty, G. S.**, M.Sc., Assoc.I.A.R.I., Ph.D. (Minn.), Wheat Breeder, Division of Botany, Indian Agriculture Research Institute, New Delhi-12.
Murty, V. K., Department of Statistics, Andhra University, Waltair.
Murthy, V. S. R., Department of Zoology, Andhra University, Waltair.

N

- Nag.**, A. C., M.Sc., D.Phil. A.C.I.I., Lecturer, Department of Statistics, University of Calcutta, Calcutta.
Nagabhushanam, R., Department of Zoology, Central College, Bangalore.
Naha, Kshitendra Mohan, Research Scholar, Geology Department, Presidency College, Calcutta.
Nair, P. V., Lecturer in Zoology, M. B. B. College, Agartala.
Nair, U. S., Professor of Statistics, Travancore University, Trivandrum.
Nanda, (Dr.) V. S., Department of Physics, University of Delhi, Delhi-8.
Narwani, (Prof.) C. S., Anand Road, Malad-P.O., Bombay.
Narayanaswami, Sellappa, Geologist, Geological Survey of India, 27, Chowringhee, Calcutta-13.
Nath, J. Swami, Geological Survey of India, 27 Chowringhee, Calcutta-13.
Nath, Pran, M.Sc., D.Sc. (Paris), D.I.C., F.S.S., Reader in Statistics and Mathematics, Banaras Hindu University, Banaras.
Naqvi, Ali M., M.Sc., M.A., Ph.D., Lecturer, Department of Physics, University of Delhi, Delhi-8.
Nigam, R. L., 15, Circular Road, Dulanwala, Dehra Dun.
Nigam, Ram Chandra, M.A., LL.B., Ph.D., Reader in Law, University Law College, Rajputna University, 6 Polo Victory Hotel, Jaipur.
Niyogi, Bimalendra Narayan, M.Sc., P16, C. I. T. Road, Calcutta-14.

O

- Ojha, D. N.**, M.Sc., F.G.M.S., Asstt. Professor, Department of Geology, Science College, Patna-5.

P

- Pal, Aswini Kumar**, Asstt. Professor of Mechanical Engineering, Jadavpur College, Calcutta-32.
Palit, (Prof.) S. R., Professor of Physical Chemistry, Indian Association for the Cultivation of Science, Jadavpur, Calcutta-32.
Patel, (Mrs.) Aster, Sri Aurobinda Ashram, Pandichery.
Pendeya, S. C., M.Sc., Ph.D., P.E.S., Botany Department, Mahakoshal Mahavidyalaya, Jabalpur.
Pillay, K. S. Madhawan, Rech. Officer, Central Research Institute, University of Travancore, Trivandrum.
Pillai, T. Subramania, Department of Zoology, Central College, Bangalore.
Prasad, R., M.Sc., M.Ed., Head of the Department of Education, Patna University, Patna Training College, Patna-4.
Prasad, R. N., M.Sc., Ph.D., Lecturer in Chemistry, B. N. College, Patna-4.

R

- Rajan, S. S.**, Assistant Cytogeneticist, Division of Botany, Indian Agricultural Research Institute, New Delhi-12.
Rajan, (Prof.) Shri, Head of the Department of Botany, University of Allahabad, Allahabad.

- Rajan, T. S. R.** Varada, Department of Statistics, Andhra University, Waltair.
- Rajeswari, (Dr.) V.,** C/o. Dr. N. R. Tawde, Professor of Physics, Karnatak University, Dharwar
- Ramachandra, S. M.,** Lecturer, Department of Aeronautical Engineering, Indian Institute of Science, Bangalore-3.
- Ramakrishnan, K. P.,** Meteorologist, Meteorological Office, Poona-5.
- Ramamurti, B.,** Ph.D., Head of the Central Statistical Organisation, Cabinet Secretariat, "B" Barracks, Queensway, New Delhi.
- Raman, M. R.,** C/o. Scientific Workers' Association, Technical Development Establishment, Post Box No. 320, Kanpur.
- Ranganekar, (Mrs.) M. P.,** D. G. Ruparel College, Tulsi Pipe Road, Matunga, Bombay-19.
- Rangnekar, P. G.,** Ramnarayan Ruia College, Matunga, Bombay-19.
- Rangnekar, Dr.) P. V.,** Department of Zoology, University of Delhi, Delhi-8.
- Rao, (Dr.) B. Ramachandra,** Department of Physics, Andhra University, Waltair, Visakhapatnam-3.
- Rao, (Prof.) Bh. S. V. Raghavan,** Professor of Chemistry, Andhra University, Waltair.
- Rao, C. L. Amba,** Lecturer, Department of Aeronautical Engineering, Indian Institute of Science, Bangalore.
- Rao, I. Ramakrishna, M.A., Ph.D. (Cal.), D.Sc. (Lond.),** Professor of Instrument Technology, Madras Institute of Technology, Chrompet, Madras.
- Rao, K. K. P. Narasinga, M.Sc., A.R.I.C.,** Chief Food Consumption and Management Section, C/o. F.A.O. of the United Nations, Viale Terme di Caracalla ROME, ITALY.
- Rao, (Dr.) L. Ramachandra,** Reader in Chemistry, Andhra University, Waltair.
- Rao, V. S., M.Sc.,** Birla College, of Science, Pilani (Rajasthan).
- Rao, V. S.,** C/o. M/s. Optico Indiana, 1/2H, Premchand Baral Street, Calcutta.
- Rao, V. V., L. Narasimha, M.A.,** Lecturer in Mathematics, Nizam College, Hyderabad-Deccan.
- Rao, Y. Sundar, M.Sc., Ph.D.,** Department of Botany, University of Saugor, Sagar.
- Ray, P. C., M.Sc., C.C.P. (Lond.),** Department of Anthropology, Government of India, Indian Museum, 27 Chowringhee, Calcutta-13.
- Registrar,** University of Roorke, U. P.
- Roy, B. C., B.A., M.D., D.Sc., M.R.C.P., F.R.C.S.,** Chief Minister, Government of West Bengal, Writers Building, Calcutta.
- Roy, Barun Kumar,** Education Department, Sir Hamilton Estate, via Canning Town, 24 Parganas.
- Roy, Jyotsna Kumar, 11A, Nandan Road, Calcutta-25.**
- Roy, Purnendu Mohan, M.Sc.,** Statistician, Department of Epidemiology, All India Institute of Hygiene and Public Health, 110, Chittaranjan Avenue, Calcutta.
- Roy, Sachin, M.Sc., Asstt. Anthropologist,** Department of Anthropology, Govt of India, Indian Museum, 27 Chowringhee, Calcutta-13.
- Roy, Saradindu, M.Sc., M.B., 12, Fern Place, Calcutta-19.**
- Roy, T. K., Sc.D. (M.I.T.), M.S., M.Sc., A.A.M.Ch.E., A.I.I.C.H.E.E.,** College of Engineering & Technology, Jadavpur, Calcutta-32.
- Roy Chowdhury, S. P.,** Nutrition Chemist, Public Health Laboratory, Patna-4.

S

- Saha, (Dr.) Narendra Nath,** Lecturer in Chemistry, Surendra Nath College, Calcutta.
- Sahu, K. C., D.P.H., D.C.H., D.T.M. & H., F.D.S.,** Assistant Professor, Skin & V. D., S. C. D. Medical College, Cuttack.

- Saksena, S. B.**, Lecturer in Botany, University of Saugor, Sagar.
- Sanyal, P. K.**, Ph.D. (Lon.), Ph.C., B.Sc., B.Sc.Pharm, Chem., F.L.S., F.R.M.S. (Lond.), Government Analyst, Provincial Drug Control, Laboratory, School of Tropical Medicine, Chittaranjan Avenue, Calcutta.
- Sanyal, (Sm.) Shobhamoyee**, C/o. Sri D. C. Sanyal, Indian Wood products Co. Ltd., Bareilly, Izatnagar.
- Sarkar, (Miss) Arati**, M.A., 40, Hindusthan Park, Calcutta-29.
- Sarma, D. V. N.**, M.Sc., 7/559, Buddhavarapu Gardens, Visakhapatnam-2.
- Sattur, P. B.**, Shukrawar Peth, Kamankatta, Dharwar.
- Satyasray, (Dr.) Ranjit Singh**, D28/161, Pandey Haveli, Banaras.
- Saxena, Satish Chandra**, C/o. Prof. B. N. Srivastava, Indian Association for the Cultivation of Science, Jadavpur College-P.O., Calcutta-32.
- Scientific Equipment Works**, 45, G. B. Road, Delhi-6.
- Sen, H. G.**, M.Sc., Department of Protozoology, School of Tropical Medicine, Chittaranjan Avenue, Calcutta.
- Sen, Kaviraj Jyotish Chandra**, Kaviratna, Member, General Council & State Faculty of Ayurvedic Medicine, West Bengal, "Bijoy Ratna Bhavan", 5, Kumartuli Street, Calcutta-5.
- Sen, (Mrs.) N. K.**, C/o. Dr. N. K. Sen, Indian Institute of Technology, Kharag-pore.
- Sen, (Dr.) N. N.**, 8-B, Shivaji Marg, Lucknow.
- Sen, Syamapada**, Microbiology Department, Bose Institute, 93/1, Upper Circular Road, Calcutta-9.
- Sen, U. K.**, Department of Mathematics, Indian Institute of Technology, Kharag-pore.
- Sen Gupta, M. B.**, Botanical Sub-Station, Pusa, Bihar.
- Sen Gupta, N. C.**, D.Sc., F.R.I.C., M.Inst.Pet., Member A.I.M.E., C/o. Dr. H. M. Das Gupta, 105-B, Rash Behari Avenue, Calcutta-29.
- Seshappa, G.**, M.Sc., Ph.D., Asstt. Research Officer, Offshore Fisheries Research Institute, Sodsoon Dock, Bombay-5.
- Sethi, Mela Ram**, Sales Engineer, M/s. National Insulated Cable Co. of India Ltd., 67/74, Stephen House, 4, Dalhousie Square, Calcutta.
- Shah, N. L.**, Zoology Department, N. Wadia College, Poona-1.
- Shah, Sumant Goculdas**, Lecturer in Physics, P. M. B. Gujrati College, Indore.
- Shanker, Uday**, M.A. (Lond.), Reader in Psychology, Central Institute of Educa-tion, Delhi.
- Sharma, Girdharilal**, Statistician, Agriculture Department, Rajasthan Jaipur, 252, Lal Bhairavapara, Katra, Jaipur.
- Sharma, Shambhu Lal**, Adult Education Officer, Rajasthan, Vice-Chairman, Vocational & Educational Guidance Bureau, Gangashahar, Bikaner.
- Sharma, (Dr. V. N.)**, Department of Pharmacology, S. M. S. Medical College, Jaipur.
- Shome, S. C.**, Ph.D. (Dacca), Ph.D. (Cal.), Professor of Chemistry, Presidency College, Calcutta.
- Siddhanta, Sushil Kumar**, M.Sc., Lecturer in Chemistry, Indian Institute of Techno-logy, Kharagpore.
- Singh, Krishna Kant**, Research Assistant, Department of Geology & Geophysics, Indian Institute of Technology, Kharagpore.
- Sinha, (Prof.) Arun Kumar**, Lecturer in Chemistry, B. N. College, Patna.
- Sircar, (Miss) Utpala**, B.Sc., 93 Upper Circular Road, Calcutta-9.
- Sokhey, S. S.**, Maj. General, Member of the Council of States, 28, Western Court, New Delhi.
- Srinivasan, (Dr.) M.**, Senior Scientific Officer, Central Food Technological Re-search Institute, V. V. Mohalla-P.O., Mysore.

- Srivastava, H. C.**, Central Food Technological Research Institute, V. V. Mohalla, Mysore.
- Srivastava, Hari Mohan Lal**, M.Sc., Assoc.I.A.R.I., F.R.E.S. (Lond.), F.R.E.S., Malariology, Government of U. P., Lucknow.
- Srivastava, K. P.**, M.Sc., Research Assistant, Botany Department, Lucknow University, Lucknow.
- Standard Scientific Apparatus & Chemical Supplies**, H.O. Ambala Cantt.
- Subramanyam, (Dr.) K.**, C/o. Shri A. Nagaraja Rao, Lecturer in Botany, Central College, Bangalore-1.
- Sukhatme, P. V.**, Director, International Training Centre on Experimental Designs, Pusa Institute, New Delhi.
- Swaminathan, M. S.**, B.Sc., Ph.D. (Cantab), Assoc. IARI, Division of Botany, Indian Agriculture Research Institute, New Delhi-12.
- Swarup, Shanti**, M.A., M.Sc., Professor of Botany, Jaswant College, Jodhpur.

T

- Tag, (Dr.) Paul**, Poona Club Ltd., Poona-1.
- Tanavde, D. S.**, Retd. Asstt. Commissioner of Income Tax, A-9, Kapur Mahal, Marine Drive, Bombay-1.
- Tandon, H. P.**, Asstt. Research Officer, Indian Veterinary Research Institute, Izatnagar.
- Tawde, (Sm.) Nalini N.**, C/o. Dr. N. R. Tawde, Professor of Physics, Karnatak University, Dharwar.
- The Technical Corporation Ltd.**, Sarojini Nagar-P.O., Lucknow.
- Thosar, V. B.**, Asstt. Director of Industries (Chem.), Industrial Research Laboratory, Dept. of Industries, Matunga, Bombay-19.
- Tummin-Katti, (Km.) Indira M.**, B.Sc., Asstt. Chemist, Karnatak Chemical Works, 5/17, Redi Colony, Dharwar.

V

- Verma, D. V.**, C/o. Scientific Workers' Association, Technical Development Establishment, Post Box No. 320, Kanpur.
- Varma, P. M.**, M.Sc., FIES, Virus Entomologist, College of Agriculture, Poona-5.
- Varma, Satish Chander**, Punjab University Botany Dept., Khalsa College, Amritsar.
- Vardya, Mahendra Singh**, M.Sc., Dept. of Physics, Delhi University, Delhi-8.
- Venkataram, C. S.**, M.Sc., M.S., Ph.D., I.C.I. Research Fellow, University Botany Laboratory, Madras-5.
- Vias, (Miss) Manorama**, Mahila College, Lucknow.

W

- Wadia, P. S.**, Chemistry Dept., Central Drug Research Institute, Lucknow.
- West, (Dr.) W. D.**, Highwood Country Club, Ellerslie Lane, Bexhill-on-Sea, Sussex (England).
- Wuleff, P. E. A.**, W.I., M.Sc., Mech. Engg. Chief Engineer, Radio Department, Philips Electrical Co. (India) Ltd., 7, Justice Chandra Madhav Road, Calcutta-20.

Y

- Yaseen, Mohd.**, Instructor, College of Agriculture, Osmania University, Hyderabad-Deccan.

SESSIONAL MEMBERS. ENROLLED AT CALCUTTA

A

- Aeanake**, (Miss) Leela Narhar, Biology Dept., Willingdon College, Sangli.
Agarwal, Indra Prakash, Asst. Professor of Anatomy, G. R. Medical College, Gwalior, M.B.
Agrawal, Ramesh Chandra, M.Sc., A.M.I.E.E. (Lond.), M/s. Krishna Chandra & Brother, Kalikothi, Muzaffarpur.
Ali, M. A., Chemical Section, Agriculture Research Institute, Sabour P.O., Bhagalpore.
Amin, Surendra R., Consulting Mining Geologist, 7-E, Rahimtoola House, Honji Street, Fort, Bombay.
Anand, (Dr.) B. M., Head of the Dept., Physics Honours School, P. U. College, Hoshiarpur.
Arogyaswami, R. N. P., A.I.S.M., Geologist, Geological Survey of India, 27, Chowringhee, Calcutta-13.
Arora, (Miss) N., Botany Dept., University of Delhi, Delhi.
Aranake, G. N., Dept. of Botany, University of Poona, Ganeshkhind, Poona-7.

B

- Ballal**, D. K., Lecturer College of Agriculture, Nagpur, M.P.
Bani, (Dr.) H. L., 22, Alipore Road, Malaria Institute of India, Delhi-8.
Banerjee, B. M., Reader, Institute of Nuclear Physics, 92, Upper Circular Road, Calcutta-9.
Banerji, Debi Prosad, M.B., 1/1/1, Krishnaram Bose Street, Shambazar, Calcutta-4.
Banerjee, Syamadas, M.Sc., Asst. Geologist, Geological Survey of India, 27, Chowringhee, Calcutta-13.
Baurah, H., Ph.D. (Cantab), Professor & Head of the Dept. of Botany, Gauhati University, Gauhati.
Baruah, (Mrs.) P., C/o. Prof. H. Baruah, Professor & Head of the Dept. of Botany, Gauhati University, Gauhati.
Basak, (Dr.) B. S., Head of the Dept. of Physics & Mathematics, Indian School of Mines & Geology, Dhanbad.
Basu Chaudhary, K. C., Lecturer, Botany Department, Agra College, Agra.
Batra, Ram Nath, C/o. M/s. Uday Electrical Equipment Co., "K" Block, Connaught Circus, Post Box No. 200, New Delhi.
Batra, (Mrs.) Vidya, C/o. M/s. Uday Electrical Equipment Co., "K" Block, Connaught Circus, Post Box 200, New Delhi.
Baxi, M. R. S., Mohamad Wadi, Baroda.
Behere, (Mrs.) S. P., C/o. Shri V. M. Dixit, Promrose Villa, Karnatak College, Dharwar.
Benson, (Mrs.) E., C/o. Prof. Morris Benson, Indian School of Mines, Govt. of India, Dhanbad.
Benson, (Prof.) Morris, Indian School of Mines, Government of India, Dhanbad.
Bhardwaj, S. N. Botany Department, Agra College, Agra.
Bhargava, (Dr.) K. N., Patankar Bazar, Lashkar, Gwalior.
Bhargava, (Dr.) P. N., Organic Chemistry Dept., College of Science, Hindu University, Banaras.
Bhat, (Dr.) N. R., Cotton Botanist, State of Bombay, Surat.
Bhatt, Y. M., C/o. Dr. K. M. Bhatt, 9, Shivalaxmi Bhavan, 2nd Khattarali Rane, Thakurdwar Road, Bombay-2.
Biswas, Nikunja Behari, Factory, Superintendent, Scientific Class Apparatus Mfg. Co., 11/2, Harinathpur Dey Road, Calcutta.

- Bommannavar**, (Prof.) S. S., Lingaraj College, Belgaun.
Botrabet, S. M., G 120, Hostel, Indian Institute of Science, Bangalore-3.
Boyce, (Dr.) C. F., Ben Nevis, Warden Road, Bombay.

C

- Chakravarti**, Indu Bhusan, M.Sc., Ph.D. (Lond.), A.R.I.C., Chief Technologist, Indian Jute Mills Association Research Institute, 17, Taratola Road, Calcutta-27.
Chakrabarti, (Miss) Prity, Professor of Botany, R. D. K. Women's College, Asansole P.O.
Chand, (Dr.) Ram, Punjab University Chemistry Dept., P. V. College, Hoshiarpur.
Chandekar, P.O., Dept. of Physics, College of Science, Nagpur. ...
Chandratveya, P. V., M.Sc., Ph.D., Physics Dept., Ruparel College, Mahim, Bombay-16.
Chatterjee, (Dr) B. G., Applied Chemistry Section, Indian Institute of Technology, Khargpur.
Chatterji, K. K., M.B.B.S., 15, Camac Street, Calcutta-16.
Chatterji, P. N., Lecturer in Zoology, Ravenshaw College, Cuttack-3.
Chatterjee, Sailendra Nath, 9A, Becharam Chatterjee Lane, Calcutta-5.
Chatterji, (Mrs.) Shanti, C/o. Dr. A. C. Chatterji, 9, Badshah Bagh, Lucknow.
Chaudhari, K. R., M.Sc., Senior Lecturer in Physics, M. S. University, Baroda.
Cherian, K. C., Research Officer, D.R.S., Post Box 1036, Reserve Bank of India, Bombay-1.
Chief Research Officer, Desert Afforestation Research Station, Jodhpur.
Chipalkathi, (Dr.) V. B., Shri Ram Institute for Industrial Research, 19, University, Road, Delhi-8.
Chopra, R. N., Botany Dept., University of Delhi, Delhi-8.
Chothia, F. S., Vocational Guidance Bureau, 3, Cruickshank Road, Bombay-1.

D

- Dadape**, (Dr.) V. V., Dept. of General Chemistry, Indian Institute of Science, Bangalore.
Dainle, Y. B., M.A., Ph.D., Lecturer in Sociology & Anthropology, Deccan College Post Graduate & Research Institute, Poona.
Daruwalla, E. H., B.Sc., M.Sc., Tech., Ph.D. (Manch.), A.R.E.C., Reader in Technology of Dying & Printing Dept. of Chemical Technology, University of Bombay, Matunga, Bombay.
Das, B. M., Central Leather Research Institute, Adyar, Madras.
Das, B. Narayan, Head, Applied Science Dept., Delhi Polytechnic, Kashmir Gate, Delhi.
Das, Gopeshar, Manager, Scientific Glass Apparatus Mfg. Co., 11/2, Harinath Dey Road, Calcutta-9.
Das, H. P., M.A., Ph.D. (Lond.), Geography Dept., Gauhati University, Gauhati.
Das, J. P. Dept. of Psychology, Ravenshaw College, Cuttack-3.
Das, N. B., Ph.D., Bio-Chemist, Indian Agriculture Research Institute, New Delhi.
Das Gupta, (Mrs.) N. N., 44, Hazra Road, Calcutta-19.
Das Gupta, S. K., M.Sc., 18, Deshpriya Park Road, Calcutta-26.
Dass, B. K., D.Sc. (Lond.), Fisheries Dept., Hyderabad Govt., Hyderabad-Dn.
Datta, Bimal Chandra, Chemical Engineering Dept., Indian Institute of Technology, Kharagpur.

- Datta, R. L.**, M.Sc., Ph.D. (Lond.), Chemical Engineering Dept., Indian Institute of Science, Bangalore.
- Deo, (Dr.) P. G.**, Rai Beharilal Road, Lucknow.
- Deo, (Sm.) Prativa**, Rai Beharilal Road, Lucknow.
- Desai, (Dr.) D. M.**, Chemistry Dept., Institute of Science, Mayo Road, Fort, Bombay.
- Desai, N. D.**, Agriculture Officer, I/C, Cotton Breeding Section, Surat.
- Desai, S. C.**, Divn. Statitian, Baroda, Bombay State Road Transport Corporation, 80-81, Dr. A. B. Road, Worli, Bombay.
- Deshpande, L. B.**, Superintendent, Govt. Experimental Farm, Nagpur.
- Deshpande, (Prof.) L. V.**, M. N. College, Via Meshana, Visnagar.
- Deshpande, T. L.**, Lecturer, College of Agriculture, Nagpur.
- Devi, (Mrs.) Padmini**, M.A., 36, New Street, Mannady P.O., Madras-1.
- Dey, A. N.**, D.Sc. (Lond.), D-es-Sc. (Paris), D.I.C., Senior Scientific Officer, T.D.E.L., 144, Canal Range, Cantonment, Kanpur.
- Dhopeshwarkar, G. A.**, M.Sc., Ph.D., C/o. Dr. R. A. Lewis, M.D., Pharmacology Dept., Seth G. S. Medical College, Parel, Bombay.
- Dixit, S. N.**, Dept. of Botany, University of Delhi, Delhi.
- Dubey, Ananda Sekhar**, Botany Dept., Ravenshaw College, Cuttack-3.
- Dubey, Krishna Chandra**, Dept. of Geology, University of Sauger, Sagar, M.P.
- Dutta, (Mrs.) Sabitri**, C/o. Dr. S. K. Datta, 67, Southern Avenue, Calcutta-29.

G

- Gangadharam, P. R. J.**, Pharmacology Laboratory, Indian Institute of Science, Bangalore-3.
- Gaur, (Dr.) H. C.**, Lecturer in Chemistry, University of Delhi, Delhi.
- Ghosh, A. B.**, Division of Chemistry, Indian Agriculture Research Institute, New Delhi.
- Ghosh, (Miss) M.**, Botany Dept., University of Delhi, Delhi.
- Ghosh, S. B.**, Asst. Chemical Examiner to the Govt. of W. B., Chemical Dept., Medical College, Calcutta.
- Ghosh, S. P.**, M.Sc., D.Phil., Ph D., A.R.I.C., Chemistry Dept., Patna University, Patna.
- Ghosh, Subrata**, B.Sc., A.I.S.M., Geologist, Fuel Research Institute, Jcolgora P.O., Manghum.
- Ghoshal, (Dr.) S. N.**, Reader in Physics, Institute of Nuclear Physics, 92, Upper Circular Road, Calcutta.
- Ghurye, (Mrs.) Charlotte**, C/o. Shri S. G. Guurye, Reader, Dept. of Mathematics & Statistics, Lucknow University, Lucknow.
- Ghurye, S. G.**, Reader in Statistics, Dept. of Mathematics & Statistics, Lucknow University, Lucknow.
- Gokhale, S. R.**, Asst. Statistician, Bombay State Road Transport, Central Workshop, Dapodi, Bombay.
- Goswami, S. L.**, M.D., Dept. of Pharmacology, G. R. Medical College, Gwalior.
- Govindarajan, (Dr.) S. V.**, Agricultural Chemist, Department of Agriculture, Bangalore.
- Guha, (Dr. Miss) Phulrenu**, M.A., D.Litt. (Paris), 55/5, Manaharpukur Road, Calcutta-29.
- Gunjkar, K. R.**, M.A. (Cantab), Retired Professor of Mathematics & Principal Elphiston College, Bombay.
- Gupta, A.**, Chemist-in-charge, Development Research Laboratory, Assam Oil Company Ltd., Digboi.

- Gupta**, Anadi Sankar, C/o. Sri M. L. Sen Gupta, Bengal Immunity Research Institute, 39, Lower Circular Road, Calcutta-16.
- Gupte**, Kusum R., Biology Dept., R. R. College, Matunga, Bombay.
- Gupte**, R. L., B.Ag., Ph.D., Assoc., I.A.R.I., Entomologist to the Govt. of Madhya Pradesh, Nagpur.
- Gupte**, S. Y., Demonstrator, Biology Dept., N. N. College, Visnagar.

H

- Hafiz**, Syed Anwarul, M.B.B.S. (Cal.), House Physician, Chest Dept., Medical College Hospital, Calcutta.
- Handa**, K. L., Research Chemist, Drug Research Laboratory, Jammu (Kashmir State).
- Hansen**, Thomas L., Professor of Agriculture, Bengal Engineering College, Botanic Garden P.O., Howrah.
- Hewetson**, Dy. Chief Conservator of Forests, Nagpur.
- Heeramanack**, D. R., 12, Alexandra Road, New Gamdevi, Bombay.
- Honrao**, M. S., Lecturer, Department of Geography, Karnatak College, Dharwar.

I

- Indiresan**, P. V., Roorkee (U.P.).
- Indulkar**, V. V. Rao, Dept. of Electrical Communication, Indian Institute of Technology, Kharagpore.
- Ingersoll**, Alfred C., M.Sc., Ph.D., Professor of Applied Mechanics, Bengal Engineering College, Botanic Garden-P.O., Howrah.
- Iyer**, (Mrs.) S. G., C/o. Shri S. G. Iyer, Head, Division of Poultry Research Indian Veterinary Research Institute, Izatnagar.

J

- Jain**, (Dr.) B. D., 18C, Maurice Nagar, University of Delhi, Delhi-8.
- Jagannadham**, A. V., Adarshnagar, Ajmer.
- Jagtap**, P. N., Lecturer Department of Geology, University of Saugor, Sagar.
- Jatti**, (Prof.) V. V., Vice-Principal, Lingraj College, Belgaum.
- Jit**, (Dr.) Inder, Professor of Anatomy, Medical College, Amritsar.
- Joseph**, (Dr.) A. D., Professor of Pharmacology, B. J. Medical College, Ahmedabad-11.
- Joshi**, B. D., Dept. of Spectropics, College of Science, Banaras Hindu University Banaras.
- Joshi**, R. V., M.Sc., Demonstrator in Physics, M. S. University, Baroda.
- Joshi**, (Dr.) R. V., Dept. of Geology, Karnatak, University, Dharwar.

K

- Kabadi**, (Mrs.) Suniti M., C/o. Dr. M. B. Kabadi, Professor of Physical Chemistry, The Institute of Science, Mayo Road, Fort Bombay.
- Kale**, (Prof.) Shrikrishna V., M.A., A.M., Ph.D., 551, Shaniar Peth, Vartak Wada, Poona-2.
- Kalia**, (Dr.) P. N., Punjab University Physics Dept., P. U. College, Hoshiarpur.

- Kalyankar, (Dr.) G. B.**, Dept. of Biochemistry, Indian Institute of Science, Bangalore-3.
- Kamat, A. R.**, M.Sc., Ph.D. (Lond.), Head of the Department of Mathematics & Statistics, Ferguson College, Poona-4.
- Kanekar, C. R.**, The Institute of Science, Mayo Road, Fort, Bombay.
- Kanungo, M. S.**, Revenshaw College, Cuttack.
- Kapil, R. N.**, Botany Dept., University of Delhi, Delhi-8.
- Khambata, (Dr.) S. R.**, Fermentation Technology Laboratory, Indian Institute of Science, Bangalore-3.
- Khandekar, P. V.**, Lecturer, College of Science, Nagpur.
- Kharkar, D. P.**, Dept. of General Chemistry, Indian Institute of Science, Bangalore-3.
- Khosla, B. D.**, M.Sc., Lecturer in Chemistry, University of Delhi, Delhi-8.
- Koppikar, (Dr.) R. P.**, M.S., Professor of Anatomy, Medical College, Jaipur.
- Kothari, L. S.**, 5, University Road, Delhi-8.
- Kotte, S. G.**, Asst. Economic Botanist, Office of the Economic Botanist to the Government of Madhya Pradesh, Nagpur.
- Krishnamurthy, P.**, C/o. Fine Pharmaceuticals, 87, Motilal Street, Kumbakonam (South India).
- Kulkarni, L. Y.**, Geography Dept., Karnatak College, Dharwar.
- Kumar, (Mrs.) Myra**, H.M.D., Kankee, Ranchi.

L

- Lad, (Km.) Vasundhara Shripad**, Soil Physics Section, Sugarcane Research Station, Padegaon, Nira R. S., Poona.
- Laha, Radha Govinda**, 1/A, Ramchand Nandy Lane, Calcutta-6.
- Land, B. B.**, M.Sc., Ph.D., Dept. of Physics, University of Poona, Poona-7.
- Lewis, Roger A.**, W.H.O. Professor of Pharmacology, S. G. S. Medical College, Bombay-12.

M

- Maheswari, J. K.**, Dept. of Botany, Delhi University, Delhi-8.
- Maitra, (Prof.) A. T.**, Physics Dept., L. S. College, Muzaaffarpur.
- Majumdar, Bibhuti Ranjan**, B.Sc. (Ag.), Assoc. I.A.R.I., Research Assistant, Crop Research, West Bengal, 46, M. N. Sen Lane, Calcutta-40.
- Majumdar, V. D.**, Professor of Physics, Bhavan's College, Andheri, Bombay-41.
- Malhotra, C. P.**, Entomology Dept., Indian Lac Research Institute, Namkum, Ranchi
- Marathy, (Dr.) M. G.**, Dept. of Chemistry, University of Poona, Poona-4.
- Mathur, (Dr.) B. B. L.**, Lecturer in Physiology, M. G. M. Medical College, Indore.
- Mathur, (Dr.) P. N.**, Head of the Dept. of Zoology, Govt. College, Ajmer.
- Mehra, K. N.**, Indian Veterinary Research Institute, Izatnagar.
- Mehta, B. V.**, M.Sc., Ph.D., Institute of Agriculture, Anand (W. Railway).
- Mirashi, M. V.**, "Vishnu Sadan", Dharampeth, Nagpur.
- Misra, D.**, M.A., A.M. (Columbia), Ph.D., Principal, S. K. C. G. College, Parlakimedi-P.O., Ganjam.
- Mishra, Kartik Nath**, Lecturer in Physics, Science College, Patna.
- Misra, (Mrs.) Savitri**, M.A., L.T., C/o. Dr. R. C. Misra, Reader in Geology, Lucknow University, Lucknow.
- Mitra, (Mrs.) R.**, C/o. Sri S. B. Mitra, 14, Dass Lane, Calcutta-12.
- Mitra, (Mrs.) S. K.**, C/o. Sri S. K. Mitra, Suite 8, 26, Chowringhee, Calcutta-13.

- Modak**, H. V., Dept. of Physics, M. W. College, Poona-1.
Mohanty, Debendra Nath, Lecturer in Botany, Ravenshaw College, Cuttack-3.
Mukerji, (Miss) Anima, Lecturer, Mohila College, Lucknow.
Mukherjee, Amal Bhusan, M.Sc., Lecturer in Zoology & Entomology, State Agriculture College, Rani Kuthi, Tollygunge, Calcutta.
Mukherjee, S. K., Institute of Nuclear Physics, 92, Upper Circular Road, Calcutta-9.
Mullick, O. P., Central Glass & Ceramic Research Institute, Jadavpur, Calcutta-32.
Murti, C. C. Narasimha, Lecturer in Zoology, Andhra University, Waltair, Visakhapatnam-3.
Murthy, (Dr.) G. V. S., Professor of Medicine, Andhra Medical College, Visakhapatnam-2.
Murti, (Dr.) N. N., Principal, Ramnarayan Ruia College, Matunga, Bombay-19.

N

- Nadkarni**, G. B., M.Sc., "Fintona", Narayan Dabholkar Road, Malabar Hill, Bombay-6.
Nagaraj, M., Asst. Professor of Botany, Central College, Bangalore-3.
Nair, K. P. Ramchandran, Division of Mineral Survey, Central Research Institute, Trivandrum-1.
Nandy, Kalipada, Physics Department, Indian Institute of Technology, Kharagpure.
Nandy, (Prof.) S. K., Chemical Engineering Dept., Indian Institute of Technology, Kharagpure.
Nargund, K. S., M.Sc., Ph.D., D.I.C., A.I.I.Sc., Professor of Chemistry, Karnatak University, Dharwar.
Narang, (Miss) N., Dept. of Botany, Delhi University, Delhi-8.
Narasimhan, R. K., Civil Engineering Dept., Indian Institute of Technology, Kharagpure.
Narasimhamurty, (Dr.) G. S. R., Lecturer, Andhra University, Waltair.
Narayana, R., Dept. of Botany, University of Delhi, Delhi-8.
Narayanawamy, K., B.Sc., B.E., Lecturer, Inter Combustion Engineering Dept., Indian Institute of Science, Bangalore-3.
Nathaniel, E. J. H., M.B.B.S., Dept. of Anatomy, Christian Medical College, Vellore-P.O., South India.
Nayak, U. R., Dept. of Organic Chemistry, Indian Institute of Science, Bangalore-3.
Nayar, P. S. B., C/o. Statistical Dept., The Ahmedabad Textile Industry's Research Association, Navarangpura, Ahmedabad-9.

P

- Pandhye**, (Dr.) M. R., Dept. of Chemical Technology, University of Bombay, Matunga, Bombay-19.
Pai, (Dr.) M. L., Lecturer in Biochemistry, Medical College, Baroda.
Pan, (Dr.) M., M.B., F.R.C.S., Calcutta National Medical College, 32, Gorachand Road, Calcutta-14.
Pandya, A. C., B. A. College of Agriculture, Anand.
Pani, (Dr.) S., Lecturer in Chemistry, Ravenshaw College, Cuttack-3.
Pant, D. D., D.Sc., Jubilee Grove, Nainital.
Parsai, (Dr.) P. S., E.A.D. of Agriculture I/c. Hort, Dev. Pachuraru, M.P.
Panigrahi, (Dr.) G., Lecturer in Botany, Ravenshaw College, Cuttack.
Pant, C. M., Irrigation Research Institute, Roorkee (U.P.)
Patel, B. M., B.Sc., M.S., Ph.D., Institute of Agriculture, Anand (W. Railway).
Patankar, (Dr.) V. N., Statistics Dept., The Ahmedabad Textile Industry's Research Association, Navarangpura, Ahmedabad-9.

- Patel, (Prof.) B. N.**, Institute of Jute Technology, 35, Ballygunge Circular Road, Calcutta-19.
- Patel, C. C.**, Ph.D., Lecturer in Organic Chemistry & General Chemistry, Indian Institute of Science, Bangalore-3.
- Patel, R. M.**, B.Sc., M.S., Ph.D., Institute of Agriculture, Anand (W. Railway).
- Patil, H. N.**, M.Sc., Lecturer in Physics, M. N. College, Visnagar (N. Gujrat).
- Patil, S. K.**, Soil Survey Officer, Sugarcane Research Station, Padegaon, Nira R. S.-P.O., Poona-Dt.
- Pendse, Hrishikesh Krishna**, M.Sc., Ph.D., 223A, Sadashiv Peth, Behind Training College, Poona-2.
- Phadke, (Dr. Miss) R.**, Dept. of Organic Chemistry, Indian Institute of Science, Bangalore-3.
- Phadke, R. S.**, Dept. of General Chemistry, Indian Institute of Science, Bangalore-3.
- Pickett, Gerald**, Professor of Civil Engineering, Bengal Engineering College, Botanic Garden-P.O., Howrah.
- Pillai, K. K. N.**, Research Officer, Public Health Laboratory, Trivandrum.
- Pillai, (Dr.) P. Parameswaran**, Professor of Applied Chemistry, University of Travancore, Trivandrum.
- Pradhan, K. B.**, Bhasin Nivas, 515, College Road, Matunga, Bombay-19.
- Pramanik, Himansu Ranjan**, Deputy Director, River Research Institute, Mohanpur-P.O., Nadia (West Bengal).
- Prasad, Chandrika**, D.Phil. (Oxon), Reader in Mathematics, Roorkee University, Roorkee.
- Prasad, Hargobind**, M.B., D.P.H., D.T.M. & H., Kadamkuan, Patna-3.
- Prasad, (Prof.) J.**, 25, University of Roorkee, Roorkee (U.P.)
- Prasad, (Mrs.) J. G.**, C/o. Sri S. R. Sinha, 719, University Road, Allahabad-2.
- Prasad, M. R. N.**, Dept. of Zoology, Central College, Bangalore.
- Pruthi, (Mrs.) Harbans**, Bunglow No. 14, Block 4, Northern Extension, New Delhi-5.

Q

- Qadri, Abdul Jamil**, Lecturer Dept. of Phil. & Psychology, Muslim University, Aligarh.

R

- Raghavan, M. R.**, B.E., Lecturer in Mechanical Engineering, Dept. of Power Engineering, Indian Institute of Science, Bangalore-3.
- Rajagopalan, (Dr.) R.**, Dept. of Biochemistry, Indian Institute of Science Bangalore-3.
- Raman, K.**, M.Sc., Research Student, Organic Chemistry Dept., Indian Institute of Science, Bangalore-3.
- Ramaiah, (Dr.) N. A.**, Lecturer in Chemistry, University of Delhi, Delhi-8.
- Ramasastri, (Dr.) C.**, Head of the Dept. of Physics, Indian Institute of Technology, Kharagpore.
- Ramasami, L. S.**, D.Sc., Asst. Professor of Zoology, Central College, Bangalore-1.
- Rao, B. K. Subba**, B.Sc., B.E., Technical Asst., Mech. Engineering Dept., Dept. of Power Engineering, Indian Institute of Science, Bangalore-3.
- Rao, C. Narayana**, The Andhra Scientific Co. Ltd., Masulipatnam, Krishna-Dt.
- Rao, (Dr.) Chellapilla Surya Prakasa**, Dept. of Botany, Banaras Hindu University, Banaras-5.

- Rao, (Dr.) J. Thuljaram**, Asst. Botanist, Sugarcane Breeding Institute, Lawbey Road, Coimbatore.
- Rao, M. L. N.**, Manager, The Andhra Scientific Co. Ltd., Masulipatnam, Krishna-Dt.
- Rao, M. R. K.**, B.E., A.M.I.E., Asst. Professor, Inter Combustion Engg. Dept., Indian Institute of Science, Bangalore-3.
- Rao, M. Rama**, Meteorologist, The Observatory, Lodi Road, New Delhi.
- Rao, (Dr.) M. Srirama**, Professor of Geology, Mahakoshal Mahavidyalaya, Jabalpure.
- Rao, Mokka Narasingha**, D.Sc., Ph.D., Reader, Dept. of Chemical Technology, Andhra University, Waltair.
- Rao, N. A. N.**, Pharmacology Section, Indian Institute of Science, Bangalore.
- Rao, (Prof.) N. C. S.**, Professor of Psychology, P. S. Mahavidyalaya, Jabalpure.
- Rao, P. V. Subba**, The Andhra Scientific Co. Ltd., Masulipatnam, Krishna-Dt.
- Rao, R. Seshagiri**, M.Sc., Botanical Survey of India, Indian Botanic Garden, Howrah.
- Rao, T. S.**, Chief Engineer, The B. E. S. & T. Undertaking, Electric House, Fort, Bombay-1.
- Rao, V. S.**, Professor of Botany, Ramnarayan Ruia College, Matunga, Bombay-19.
- Rideocut, (Prof.) V. C.**, Dept. of Electrical Communicating Engineering, Indian Institute of Science, Bangalore-3.
- Rout, M. K.**, M.Sc., Ph.D., Dept. of Chemistry, Ravenshaw College, Cuttack-3.
- Roy, B. B.**, M.Sc., Ph.D., A.R.I.C., Research Officer, Central Water & Power Research Station, Poona-1.
- Roy, (Mrs.) L.**, C/o. Dr. B. B. Roy, Research Officer, Central Water & Power Research Station, Poona-3.
- Roy, (Mrs.) Madhabi**, 23, Camac Street, Calcutta-16.
- Roy, P.**, Asst. Research Officer, River Research Institute, Mohanpur-P.O., Nadia.
- Roy, S. B.**, Central Glass & Ceramic Research Institute, Jadavpur, Calcutta-32.
- Roy Chowdhury, K.**, M.Sc., Research Asstt. (Horticulture), Horticultural Research Station, Krishnagar-P.O., Nadia.
- Roy Choudhury, N. K.**, Chemical Engineering Dept., Indian Institute of Technology, Kharagpore.

S

- Sachar, R. C.**, Dept. of Botany, Delhi University, Delhi.
- Sahay, J. N.**, Ph.D., Ph.D. (Lond.), Head of the Dept. of Chemistry, Ranchi College, Ranchi.
- Sahni, (Mrs.) Savitri**, President, Palaeobotanic Society, Lucknow, 53, University Road, Lucknow.
- Sant, G. K.**, Asst. Statistician, Bombay State Road Transport Corporation, Worli, Bombay-18.
- Sanyal, T.**, C/o. Messrs. Adair Dutt & Co. (India) Ltd., The National Bank Buildings, Sir Phirozshah Mehta Road, Bombay-1.
- Sarkar, (Mrs.) Manju**, C/o. Dr. A. C. Sarkar, Disergarh Power Supply & Associated Power Co., Disergarh-P.O., Burdwan.
- Sarkar, (Mrs.) Purnima**, C/o. Prof. H. L. Sarkar, Dept. of Zoology, Delhi University, Delhi.
- Sarkar, S. N.**, Asst. Research Officer, River Research Institute, Mohanpur, Nadia (West Bengal).
- Sarkar, (Dr.) S. N.**, Dept. of Geology, Indian Institute of Technology, Kharagpore.
- Saref, (Dr.) J. R.**, Physics Dept., Lucknow University, Lucknow.
- Sastri, (Dr.) M. L.**, Senior Scientists, Defence Science Organisation, N. P. L. Buildings, Pusa, Hill Side Road, New Delhi-12.

- Sastri, (Dr.) M. V. C.**, Applied Chemistry Section, Indian Institute of Technology, Kharagpore.
- Saxena, A. N.**, M.Sc., Institute of Nuclear Physics, 92, Upper Circular Road, Calcutta-9.
- Sen, A. R.**, M.Sc., Ph.D., Additional Statistician, Economics & Statistics Section, Civil Secretariat, Havelock Road, Lucknow.
- Sen, (Capt.) Atmajyoti**, M.B., Medical Officer, Indian Paper Pulp. Co. Ltd., Hazzinagar-P.O., 24 Pargonas.
- Sen, (Sm.) Bijoya**, 6, Turf Road, Calcutta-25.
- Sen, (Sm.) Chitra**, M.A., Lecturer in Geology, Hooghly Women's College, Cal.
- Sen, (Mrs.) Preety**, 164, Manicktola Main Road, Calcutta-11.
- Sen, (Sm.) Prity Prova**, C/o. Capt. Atmajyoti Sen, M.B., Medical Officer, Indian Paper Pulp Co. Ltd., Hazinagar-P.O., 24 Pargonas.
- Sen, Rathindra Nath**, C/o. Hindusthan Co-Operative Insurance Society Ltd., Broj Kishore Peth, Patna.
- Sen Gupta, Anil Bhusan**, M.Sc., Ph.D., F.T.I., A.R.I.C., Chief Chemist, Indian Jute Mills Association Research Institute, 17, Taratola Road, Cal.-27.
- Senapati, J. M.**, M.B.B.S., Medical Officer, Community Project, Bhanjangan, Ganjam.
- Sethna, R. M.**, C/o. Messrs. J. T. Jagtiani, National House, 6, Tulloch Road, Apollo Bunder, Post Box No. 332, Bombay-1.
- Shah, D. C.**, C/o. Messrs. D. C. Shah & Co., Devkaran Buildings, No. 3), 2nd floor, 43, Princes Street, Bombay-2.
- Shah, Hasmukh M.**, The Hindusthan Chemical Works Ltd., Advani Chambers, Sir Phirozshah Mehta Road, Bombay.
- Shah, Jayant C.**, Chemist, Govt. Industrial Training Workshop, Railwayapura, Ahmedabad-2.
- Shah, M. T.**, The Hindusthan Chemical Works Ltd., Advani Chambers, Sir Phirozshah Mehta Road, Bombay.
- Sharma, A. K.**, Botany Dept., University College of Science, 35, Ballygunge Circular Road, Calcutta-19.
- Sharma, B. L.**, Partner, M/s. Gour Scientific Metal Works, Ambala Cantt.
- Sharma, Chander Prakash**, Prop. The Satya Electric Works, Hari Pershad Buildings, Nicholson Road, Ambala Cantt.
- Sharma, K. D.**, M.Sc., Central Glass & Ceramic & Research Institute, Jadavpur, Calcutta-32.
- Sharma, (Mrs.) N. L.**, C/o. Prof. N. L. Sharma, Indian School of Mines & Applied Geology, Dhanbad.
- Sharma, P. K.**, Punjab University, Physics Dept., P. U. College, Hoshiarpur.
- Sharma, P. L.**, Dept. of Mathematics, University of Saugor, Sagar.
- Singbal, B. V.**, Tata Institute of Fundamental Research, Apollo Pier Road, Bombay-1.
- Singh, Harbhajan**, M.Sc., Asst. Meteorologist, Central Water & Power Research Institute, 'Bikaner House', New Delhi.
- Singh, M. K.**, C/o. Instrument & Equipments, 35, Chittaranjan Avenue, Calcutta-20.
- Singh, R. L.**, M.A., Ph.D., Dept. of Geology, Banaras Hindu University, Banaras.
- Singh (Dr.) R. N.**, Dept. of Botany, Hindu University, Banaras.
- Singh, R. S.**, Dept. of Spectroscopy, Banaras Hindu University, Banaras.
- Singha, D. P.**, C/o. Messrs. S. K. Biswas & Co., 137, Bowbazar Street, Calcutta.
- Sinha, P. C.**, M.Sc., Ph.D., Professor & Head of the Dept. of Chemistry, Patna University, Patna-5.
- Sinha, S.**, M.Sc., Ph.D., F.N.A.Sc., Professor & Head of the Dept. of Botany, Agra College, Agra.

- Sinha, (Mrs.) S.**, C/o. Dr. Sudarshan Prosad Sinha, Professor of Physics, L. S. College, Muzaffarpur.
- Sinha, S. K.**, Lecturer in Botany, Revenshaw College, Cuttack.
- Sinha, (Dr.) Sudarshan Prosad**, Professor of Physics, L. S. College, Muzaffarpur.
- Sirdeshmukh, (Miss) K. B.**, C/o. B. R. Sivedeshmukh, Pleader, Station Road, Thana, Bombay.
- Sreenivas, A.**, B.Sc., B.Ch.E., Chemical Engineer, Central Electro Chemical Research Institute, Alagappa College, Karaikudi.
- Shrikhande, S. S.**, Dept. of Mathematics, College of Science, Nagpur.
- Shukla, K. P.**, Irrigation Research Institute, Roorkee. (U.P.).
- Soota, T. D.**, Zoological Survey of India, 34, Chittaranjan Avenue, Calcutta.
- Soren, Sunaram**, Minister, Labour Commerce Tribal & Rural Welfare, Orrissa, Bhubaneswar Capital.
- Soundarajan, S.**, Dept. of General Chemistry, Indian Institute of Science, Bangalore-3.
- Srinivasan, T. P.**, Tata Institute of Fundamental Research, Apollo Pier Road, Bombay.
- Srinivasachari, H. R.**, Dept. of Zoology, Central College, Bangalore-1.
- Srivastava, G. P.**, B.Sc., Pharm. Chem., M. Pharm., Department of Pharmaceutical, Banaras Hindu University, Banaras.
- Srivastava, Krishna Murari**, Dept. of Archaeology, Alkapuri, Baroda.
- Srivastava, R. P.**, Irrigation Research Institute, Roorkee (U.P.).
- Subbaratnam, N. R.**, University of Saugor, Sagar (M.P.).
- Subhadramma, (Miss) G. V.**, Wireless Laboratories, Physics Dept., Banaras Hindu University, Banaras.
- Subramanyam, M. R.**, M.A., Ph.D., Geologist, Geological Survey of India, 27, Chowringhee, Calcutta-13.
- Subramanyam, (Sm.) Rajalakshmi**, C/o. Dr. M. R. Subramanyam, Geologist, Geological Survey of India, 27, Chowringhee, Calcutta-13.
- Subramanian, (Dr.) V. S. Venkata**, Physics Dept., Indian Institute of Science Bangalore-3.
- Sukheswala, R. N.**, Geology Department, St. Xaviers College, Cruickshank Road, Bombay-1.
- Surange, (Dr.) K. R.**, "Rama Kutii", Forsyth Road, Lal-bag, Lucknow.
- Swami, S. Govinda**, B.A., M.Sc., Ph.D., Sugarcane Breeding Institute, Lawbey Road, Coimbatore.

T

- Talpade, (Dr.) C. R.**, Bombay College, Dadar, Bombay-18.
- Thakkar, R. C. M.**, Ph.D. (Zurich), National Carbon Co. (India) Ltd., Sir Phirozeshah Mehta Road, Laxmi Buildings, Bombay-1.
- Thakur, (Sm.) Madhusudan K.**, C/o. R. G. Dandekar, 134, Lokamanya Nagar, Bombay-16.
- Thakur, (Dr.) R. L.**, Central Glass & Ceramic Research Institute, Jadavpur Calcutta-32.
- Tirunarayanam, M.A.**, B.Sc., B.E., Lecturer, Mechanical Engineering Section, Department of Power Engineering, Indian Institute of Science, Bangalore.

U

- Unique Trading Corporation**, 51-53, Babu Ganu Road (New Hanuman Lane), Bombay-2.
- Upadhyaya, (Miss) Jaibharati**, C/o. Adersh Bal Mander, Linking Road, Khar, Bombay-21.

V

- Vaidya**, (Dr.) B. K., The Ahmedabad Textile Industries Research Association, Navarangpura, Ahmedabad-9.
- Vaidyanathan**, C. S., Department of Biochemistry, Indian Institute of Science, Bangalore-3.
- Vaish**, Kidar Nath, 75, Ram Gopal Vidhyant Road, Maqboolganj, Lucknow.
- Vakil**, Madanlal H., Tata Chemicals Limited, Merchantile Buildings, 10 Lall Bazar, Calcutta.
- Varma**, B. S., Junior Research Officer, C. F. P. Branch, Forest Research Institute, Dehra Dun.
- Vasil**, I. K., Department of Botany, Delhi University, Delhi-8.
- Vengsarkar**, S. C., M.D., F.C.P.S., Dean & Superintendent, Topiwala National Medical College & B. Y. L. Nair Ch. National Hospital, Dr. A. L. Nair Road, Bombay-28.
- Venkatachari**, T. P., Chief Statistician, Bombay State Road Transport Corpn., Worli, Bombay-18.
- Venkatesh**, C. S., Department of Botany, University of Delhi, Delhi-8.
- Venkatesh**, H. G., Department of Physics, Indian Institute of Technology, Kharagpore.
- Venkateswarlu**, D., M.Sc., Engg., A.R.I.C., Lecturer, Department of Chemical Engineering, Indian Institute of Technology, Kharagpore.
- Verma**, B. S., M.Sc. (Ag.), Research Asstt. (Vegetable), Horticultural Research Station, Krishnanagar-P.O., Nadia-District.
- Villemonte**, James R., Professor of Applied Mechanics, Bengal Engineering College, Botanic Garden-P.O., Howrah.
- Vishnoi**, H. S., Department of Zoology, University of Delhi, Delhi-8.
- Vora**, (Dr.) V. C., Junior Scientific Officer, Central Drug Research Institute, Chattar Manzil Palace, Lucknow.

W

- Wadhwani**, T. K., Section of Pharmacology, Indian Institute of Science, Bangalore-3.

STUDENT MEMBERS ENROLLED AT CALCUTTA

A

- Achyutorao**, I., Basavaraju Kameswararao Jaru, Brahmin Street, Bezwada.
Agarkar, P. S., Department of Geology, University of Saugor, Sagar.
Aggarwala, B. D., Department of Mathematics, Indian Institute of Technology, Kharagpore.
Ajmani, Bal Raj, 36/F/1, Girish Mukherjee Road, Calcutta-25.
Ambekar, V. R., Ferguson College, Poona-4.
Amin, J. V., M.Sc., C/o. Dr. C. C. Shah, Institute of Agriculture, Anand.
Athavale, (Dr.) J. M., Department of Chemistry, University of Poona, Poona-4.

B

- Badve**, D. V., Research Fellow, "Indradhanu", Poona-7.
Balsara, (Miss) Dogdo A., C/o. Young Ladies High School, 33, Murzban Road, Fort, Bombay-1.
Bandyopathay, Debabrata, Department of Inorganic Chemistry, Indian Association for the Cultivation of Science, Jadavpur, Calcutta-32.
Banerji, Barundeb, Zoological Laboratory, University College of Science, 35, Ballygunge Circular Road, Calcutta-19.
Banerjee, D. K., 197, Missirpokra, Banaras.
Banerjee, S., Department of Applied Chemistry, Indian Institute of Technology, Kharagpore.
Banerjee, Sahadeb, Applied Chemistry Section, Indian Institute of Technology, Kharagpur.
Banerjee, Siddheswar, C/o. Prof. A. K. Majumdar, Professor of Inorganic Chemistry, College of Engineering & Technology, Jadavpur, Calcutta-32.
Bendale, D. S., Department of Chemistry, University of Poona, Poona-4.
Bhadra, B., C/o. Dr. A. Chatterjee, Naxulbari-P.O., Darjeeling.
Bhadra, (Sm.) Chayarani, C/o. Dr. A. Chatterjee, Naxulbari-P.O., Darjeeling.
Bhat, L. S., Department of Geology, Karnatak University, Dharwar.
Bhat, M. R., Chemistry Department, Gujrat College, Ahmedabad.
Bhatnagar, M. P., Christian College, Lucknow.
Bhattacharya, (Miss) Bibha, Botany Department, University College of Science, 35, Ballygunge Circular Road, Calcutta-19.
Bhattacharyya, Prodyot Kumar, Department of Statistics, University of Calcutta, Calcutta.
Bhavsar, (Miss) Madhury D., 11, Chandan Mahal, Tenth Road, Santa Cruz East, Bombay-25.
Bose, (Mrs.) Baby, C/o. Sri Saroj Kumar Bose, City College, Calcutta-9.
Bose, Mihir Kumar, 33, Abinash Sasmal Lane, Calcutta-10.
Bose, (Sm.) Sucharita, C/o. Prof. S. C. Bose, 62 Lake Place, Calcutta-29.
Bose, Sujit, C/o. Prof. S. C. Bose, 62 Lake Place, Calcutta-29.
Bose, Sukumar, C/o. Dr. A. Chatterjee, Reader in Chemistry, University College of Science, 92 Upper Circular Road, Calcutta-9.
Bysack, Amode Chandra, 14/3, Sovaram Bysack Street, Calcutta-7.

C

- Chakraborty**, A. C., Department of Applied Chemistry, University College of Science, 92 Upper Circular Road, Calcutta-9.

- Chakraborty, Amiya Kumar**, Department of Inorganic Chemistry, Indian Association for the Cultivation of Science, Jadavpur, Calcutta-32.
- Chakravarty, Priya Kanta**, 119/3, Shambazar Street, Calcutta-4.
- Chakravorty, Priya Sankar**, Ramkrishna Mission Students Home, 18-20, Jadulal Mullick Road, Calcutta-6.
- Chakrabarty, S. R.**, Department of Applied Chemistry, University College of Science, 92 Upper Circular Road, Calcutta-9.
- Chakravarti, Sunil Krishna**, C/o. Dr. M. N. Goswami, Department of Applied Chemistry University College of Science, 92 Upper Circular Road, Calcutta-9.
- Chakravarty, Tarakeshwar**, C/o. Dr. A. Chatterjee, Reader in Chemistry, University College of Science, 92 Upper Circular Road, Calcutta-9.
- Chandra, Ganesh**, Research Chemist, H. B. Technological Institute, Kanpur.
- Chandra, Prasad Kumar**, Geology Department, Calcutta University, Presidency College, Calcutta.
- Chatterji, (Miss) Benu**, 9 Badshah Bagh, Lucknow.
- Chatterjee, S. P.**, C/o. Dr. G. P. Chatterjee, Bengal Engineering College, Botanic Garden-P.O., Howrah.
- Chaudhury, (Miss) Anima**, Pure Chemistry Department, Science College, 92 Upper Circular Road, Calcutta-9.
- Chaudhury, Ajoy Kumar**, Chemical Laboratory, Presidency College, Calcutta-12.
- Chibber, R. K.**, Division of Chemistry, Indian Agriculture Research Institute, New Delhi-12.
- Contractor, Sapanali J.**, 2406, Sedikola's Pole, Kalupur Gate, Ahmedabad.

D

- Dalal, (Miss) Sushila L.**, 1663 Zampada's Pole, Kalupur, Ahmedabad.
- Dange, P. S.**, C/o. Shri N. V. Kinkar, 252/12, Sadashiv Peth, Poona-2.
- Das, K. C.**, C/o. Dr. N. N. Das, Department of Physiology, University College of Science, 92 Upper Circular Road, Calcutta-9.
- Das, K. Ganesha**, Padma Sadan, Eswari Vilas Road, Jogathy, Trivandrum-1.
- Das, (Mrs.) Radharani**, C/o. Dr. N. N. Das, Department of Physiology, University College of Science, 92 Upper Circular Road, Calcutta-9.
- Das Gupta, S. K.**, 77, Dharamtala Street, Calcutta-13.
- Das Gupta, Somesh**, 2B, Parasar Road, Calcutta-29.
- Das Gupta, Sujit Kumar**, Zoological Laboratory, University College of Science, 35 Ballygunge Circular Road, Calcutta-19.
- Datta, Arunabha**, Botany Department, University College of Science, 35 Ballygunge Circular Road, Calcutta-19.
- Date, S. N.**, C/o. D. U. Gogate, Head, Physics Department, Faculty of Science, S. J. Science Institute, Baroda.
- Dave, A. S.**, Research Scholar, Department of Geology, Law College Building, Nagpur.
- Dave, (Sm.) Triguna D.**, Khijda's Pole, Shankedi Shedi, Ahmedabad.
- De, Deepesh**, Botany Department, University College of Science, 35 Ballygunge Circular Road, Calcutta-19.
- De, K. S.**, Applied Chemistry Section, Indian Institute of Technology, Kharagpore.
- De, L.**, C/o. Dr. S. P. Pathan, Department of Industrial Chemistry, Hindu University, Banaras.
- Desai, (Miss) Soona J.**, C/o. Young Ladies High School, 33, Murzban Road, Fort, Bombay-1.
- Deshpande, C. M.**, Department of Chemistry, University of Poona, Poona-4.
- Deshpande, D. D.**, Department of Chemistry, University of Poona, Poona-4.

Deshpande, D. M., Ferguson College, Poona-4.

Deshpande, G. G., Senior Research Scholar, Department of Geology, Law College, Building, Nagpur.

Deshpande, M. M., Department of Chemistry, Karnatak College, Dharwar.

Deshpande, V. V., The Institute of Science, Mayo Road, Fort, Bombay.

Dharwadkar, M. S., 61B, Azad Hall of Residency, Indian Institute of Technology, Kharagpore.

Dutta, Arun Kanti, Department of Applied Chemistry, University College^a of Science, 92 Upper Circular Road, Calcutta-9.

Dutta, J., Department of Statistics, Patna University, Patna.

Dutta, Jadugopal, Organic Laboratory, College of Engineering & Technology, Jadavpur, Calcutta-32

Dutta, Pranbandhu, C/o. Dr. P. C. Dutta, Indian Association for the Cultivation of Science, Jadavpur, Calcutta-32.

F

Fadnis, B. S., Department of Mathematics, Indian Institute of Technology, Kharagpore.

G

Galagali, R. J., M.Sc., C/o. Dr. S. S. Joshi, Principal, College of Science, Banaras Hindu University, Banaras.

Ganeshan, R., C/o. Head of the Department of Chemistry, Loyola College, Madras.

Ganguly, Diptendu, C/o. Dr. M. N. Goswami, Department of Applied Chemistry, University College of Science, 92 Upper Circular Road, Calcutta-9.

Ganeshsundaram, P. C., Phonetic, Laboratory, Deccan College Research Institute, Poona-6.

Gnanapragasam, N. S., C/o. Head of the Department of Chemistry, Loyola College, Madras.

Ganga, Dilip K., 917, Raipur Nagerlodi's Pole, Ahmedabad.

Gange, R. K., 917, Raipur Nagerbodi's Pole, Ahmedabad.

Godavari, (Miss) C. P., Botany Department, Annamalai University, Annamalai-nagar.

Godbole, P. K., Ferguson College, Poona-4.

Gore, K. G., Department of Chemistry, University of Poona, Poona-4.

Gopalakrishna, V. V., C/o. Head of the Department of Chemistry, Loyola College, Madras.

Gulati, I. B., Department of Applied Chemistry, Indian Institute of Technology, Kharagpore.

Gun, Atindra Mohan, Department of Statistics, University of Calcutta, Calcutta.

Gupta, Y. P., Chemistry Division, Indian Agriculture Research Institute, New Delhi-12.

H

Hari, M. N., 1/1, Bach Flat, Indian Institute of Technology, Kharagpore Technology-P.O., Kharagpore.

Herbert, P. S., Botany Dept., St. Xaviers College, Cruickshank Road, Bombay-1.

Hulyalkar, R. K., Department of Chemistry, S. P. College, Poona-2.

I

- Idnani, M. A.**, Division of Chemistry, Indian Agriculture Research Institute, New Delhi-12.
Irani, Nariman A., Botany Department, St. Xaviers College, Cruickshank Road, Bombay-1.
Iyer, (Miss) Jayalakshmi, III Year M.B.B.S., Lady Hardinge Medical College, New Delhi.

J

- Jain, M. K.**, Department of Mathematics, Indian Institute of Technology, Kharagpore.
Jhaveri, (Km.) D. B., Organic Research Laboratories, Institute of Science, Mayo Road, Fort, Bombay.
Jogdeo, S. M., Dept. of Chemistry, University of Poona, Poona-4.

K

- Kalyanasundaram, S.**, Research Scholar in Botany, Annamalai University, Annamalainagar.
Kameswari, (Miss) S., Applied Chemistry Section, Indian Institute of Technology, Kharagpore.
Kapadia, Zahir J., Botany Dept., St. Xaviers College, Cruickshank Road, Bombay-1.
Kar Choudhury, (Miss) Anjali, 2/1, Monoharpukur Road, Calcutta-26.
Khasgiwale, K. A., Dept. of Chemistry, University of Poona, Poona-4.
Khatri, Atam Prakash, Anthropology Dept., Delhi University, Delhi.
Kazi, S. K., Agricultural Meteorology Division, Meteorological Office, Baroda-5.
Khot, Chandrakant Gopalrao, Electrical Communication Dept., College of Engineering, Poona-5.
Kulkarni, P. S., M.Sc., 94 Kasba, Poona-2.
Kulkarni, P. V., Dept. of Physics, University of Poona, Poona-7.
Kulkarni, V. M. Dehai, Dept. of Geology, Karnatak University, Dharwar.
Kundu, Himangsu, 575, Dr. Sarat Chandra Chatterjee Road, Santragachi P.O., Howrah.
Kutar, P. J., Chemical Engineering Dept., Indian Institute of Science, Bangalore-3.

L

- Lahiri, A. K.**, Dept. of Metallurgy, Bengal Engineering College, Botanic Garden, Howrah.
Lakshminarayana, V., C/o. Dr. B. Ramachandra Rao, Reader in Physics, Andhra University, Waltair.
Lall, Moti, Jhargram Agricultural College, Jhargram, Midnapore.
Lote, S. J., 33, New Hostel, Indian Agricultural Research Institute, New Delhi.

M

- Mallikarajuneswara, V. R.**, Dept. of Organic Chemistry, Indian Institute of Science, Bangalore-3.
Mankand, A. K., Staff Quarters in Hostel, Top Floor, Ahmedabad-9.

- Marathay**, Arvind S., C/o. Dr. S. M. Marathy, 183, Girgaun Road, Bombay-4.
Mattoo, B. N., Dept. of Chemistry, University of Poona, Poona-4.
Mathur, R. M., The Institute of Science, Mayo Road, Fort, Bombay.
Mathur, S. S., C/o. Dr. S. P. Pathak, Dept. of Industrial Chemistry, Hindu University, Banaras.
Mazumdar, D. K., Dept. of Chemistry, Presidency College, Calcutta.
Mewada, Govind Shankerlal, Chemistry Dept., Gujrat College, Ahmedabad-6.
Meenaler, (Mrs.) V. R., Research Student, Annamalai University, Annamalai-nagar.
Mehta, D. M., 24, Maninagar Society, Maninagar, Ahmedabad-8.
Menon, P. G., Applied Chemistry Dept., Indian Institute of Technology, Kharagpore.
Mitra, G. K., C/o. Dr. D. N. Mitra, C-3, Kharagpore Technology, Hijli, Midnapore.
Mookerji, (Mrs.) Mohua, 9, Badshah Bagh, Lucknow.
Mookerjee, P. B., Division of Entomology, Indian Agriculture Research Institute, Izatnagar.
Mukherjee, P. R., Technological Research Laboratory, Indian Council of Jute Research, 12, Regent Park, Tollygunge, Calcutta-40.
Mukherjee, J. K., Dept. of Metallurgy, Bengal Engineering College, Howrah.
Mukherji, Ramen, Botany Dept., University College of Science, 35, Ballygunge Circular Road, Calcutta-19.
Munavalli, S. N., B.Sc. (Hons.), Dept. of Chemistry, Karnatak University Dharwar.
Murari, Madan, Chemistry Dept., Science College, Patna-5.
Murty, G. Balakrishna, Room No. 'O', Pithapur Hostel, Waltair.
Mandi, D. K., Applied Chemistry Section, Indian Institute of Technology, Kharagpore.

N

- Nair**, P. P., Dept. of Biochemistry, Institute of Science, Mayo Road, Fort, Bombay.
Nayar, P. S., Agricultural Meteorology Division, Meteorological Office, Baroda.

O

- Ojha**, V. N. Banaras Hindu University, Banaras-5.
Oza, Vasant T., Ramakrishna Coloney, Sarkhej Road, Ahmedabad-7.

P

- Padmanabhan**, K. V. Harihara, Dept. of Organic Chemistry, Indian Institute of Science, Bangalore-3.
Pakrashi, Satyesh, C/o. Dr. A. Chatterjee, Reader in Chemistry, University College of Science, 92, Upper Circular Road, Calcutta-9.
Pal, Satya Narayan, Chemistry Dept., Science College, Patna-5.
Pande, G. D., C/o. Dr. S. P. Pathak, Dept. of Chemistry, Hindu University, Banaras.
Pandya, J. R., C/o. Dr. D. V. Gogate, Head, Physics Dept., Faculty of Science, S. J. Science Institute, Baroda.
Pani, S. S., Dept. of Metallurgy, Bengal Engineering College, Botanic Garden, Howrah.
Pannirselvam, S., Research Scholar in Botany, Annamalai University, Annamalai-nagar.

- Panthaki**, (Miss) Dhun P., Botany Dept., St. Xaviers' College, Cruickshank Road, Bombay-1.
- Parikh**, N. M., Institute of Agriculture, Anand (W. Railway).
- Parikh**, V. M., Dept. of Chemistry, S. P. College, Poona-2.
- Patankar**, Shridhar Anant, Poona A. V. Griha, 624, Sadashiv, Poona-2.
- Patel**, B. R., Dept. of Geology, University of Saugor, Sagar.
- Patel**, (Km.) D., Organic Research Laboratories, The Institute of Science, Mayo Road, Fort, Bombay.
- Patel**, H. S., M.Sc., C/o. Dr. B. M. Patel, Institute of Agriculture, Anand.
- Patel**, (Dr.) S. R., Chemistry Dept., Gujrat College, Ahmedabad.
- Patel**, (Miss) Viloo M., Botany Dept., St. Xaviers' College, Cruickshank Road, Bombay-1.
- Patwardhan**, (Miss) Dwarka Vinayak, Ladies Hostel, Willingdon College, Sangli.
- Pavanaram**, S. K., C/o. Dr. L. Ramachandra Rao, Reader in Chemistry, Andhra University, Waltair.
- Phadke**, K. R., 499, Narayan Peth, Poona-2.
- Phansalkar**, V. K., Dept. of Chemistry, University of Poona, Poona-4.
- Pingle**, S. V., Ferguson College, Poona-4.
- Poddar**, Sailendra Nath, Dept. of Organic Chemistry, Indian Association for the Cultivation of Science, Jadavpur, Calcutta-32.
- Ponniah**, (Miss) Stella, Research Scholar in Botany, Annamalai University, Annamalainagar.
- Prabhu**, V. R., Research Student, Dept. of Geography, Karnatak College, Dharwar.
- Prashad**, Ram, Electronics Division, National Physical Laboratory, New Delhi.

R

- Ramachandran**, V. S., Applied Chemistry Section, Indian Institute of Technology, Kharagpore.
- Ramakanth**, J., Dept. of Mathematics, Osmania University, Hyderabad-Deccan.
- Ramanathan**, C. S., Dept. of General Chemistry, Indian Institute of Science, Bangalore-3.
- Ranadive**, N. S., Dept. of Physics, Indian Cancer Research Centre, Parel Bombay.
- Rangaswami**, K., Botany Dept., Annamalai University, Annamalainagar.
- Rao**, B. C. Narasinga, C/o. Dr. B. Ramachandra Rao, Reader in Physics, Andhra University, Waltair.
- Rao**, C. Gopalaswamy, Asstt. Geologist, No. 1099, First Cross Road, Bangalore-).
- Rao**, C. N. Ramachandra, Applied Chemistry Section, Indian Institute of Technology, Kharagpore.
- Rao**, (Mrs.) C. Saraswathy, C/o. Dr. C. B. Rao, Principal, Govt. Training College, Rajahmundry.
- Rao**, C. V. Narayana, M.Sc., C/o. Dr. V. Ramakrishna Rao, Reader in Physics, Andhra University, Waltair.
- Rao**, H. S. Rama, C/o. Dr. B. Ramachandra Rao, Reader in Physics, Andhra University, Waltair.
- Rao**, S. V. L. N., M.Sc., Dept. of Geology & Geography, Indian Institute of Technology, Kharagpore.
- Raval**, Arvind Kumar, A., Chemistry Dept., Gujrat College, Ahmedabad-6.
- Raval**, Bhogilal K., 6, Sharinagar Society, Ahmedabad-9.
- Ray**, Asit Kumar, Dept. of Inorganic Chemistry, Indian Association for the Cultivation of Science, Jadavpur, Calcutta-32.
- Roy**, (Miss) Mira, Botany Department, University College of Science, 35, Ballygunge Circular Road, Calcutta-19.
- Roy**, (Miss) Rina, 23, Camac Street, Calcutta-16.

Roy Choudhury, Rathindra Chandra Basu, 97/2, Tollygunge Road, Calcutta-26.
Roy Chowdhury, Sarbani Prasad, C/o. D. Roy Choudhury, Saidpura, Patna.
Rudra, Amitava, 1, Shibnarayan Das Lane, Calcutta-4.

S

- Sacha**, (Km.) M. J., Chemistry Dept., Gujrat College, Ahmedabad.
Saha, Nripendra Chandra, C/o. N. C. Chakraborty, Central Calcutta Boarding, 30, Sitaram Ghosh Street, Calcutta-9.
Saha, Rabindra Kumar, 33, Phulbagan Road, Entally, Calcutta-14.
Saini, R. S., Dept. of Zoology, University of Saugor, Sagar.
Sane, Chandrakant Kashinath, 125, Sadashiv Peth, Poona-2.
Saraf, V. A., Ferguson College, Poona-4.
Sarkar, Malay, 14/2, Bhaba Nath Sen Street, Calcutta.
Sarkar, (Miss) Namita, 14/2, Bhabanath Sen Street, Calcutta.
Sarkar, Samir Kumar, Dept. of Applied Chemistry, University College of Science 92, Upper Circular Road, Calcutta-9.
Sethna, (Miss) Nergish N., C/o. Young Ladies High School, 33, Murzban Road, Fort, Bombay-1.
Sen, (Miss) Indira, 164, Maniktola Main, Road, Calcutta-11.
Sen, (Miss) S., C/o. Dr. Purnendu Sen, School of Tropical Medicine, Chittaranjan Avenue, Calcutta.
Sen Gupta, Anupam, Dept. of Applied Chemistry, University College of 92, Upper Circular Road, Calcutta-9.
Sen Gupta, K., Dept. of Zoology, University College of Science, 35, Ballygunge Circular Road, Calcutta-19.
Sen Gupta, (Miss) N., 8/1, Abdul Rasul Avenue, Calcutta-26.
Shah, C. K., Staff Quarters in Hostel, 1st Floor, Ahmedabad.
Shaikh, M. A., Chemistry Dept., Willingdon College, Vishrambag, Sangli.
Sharma, A. K., New Delhi.
Sharma, R. K., Dept. of Biochemistry, The Institute of Science, Mayo Road, Fort, Bombay.
Sharma, (Dr.) Ram Avatar, C/o. Dr. R. M. Kasliwal, Professor of Medicine, Medical College, Jaipur.
Sharma, N. V. Gangadhar, C/o. Dr. B. Ramchandra Rao, Reader in Physics, Andhra University, Waltair.
Siddiqi, Md., M.A., Dept. of Mathematics, Osmania University, Hyderabad-Deccan.
Singh, B. N., M.Sc., 44, Jaffre Square, New Delhi.
Singh, D., Nizam G/1, Banaras Hindu University, Banaras.
Singh, S. K., Electronics Division, National Physical Laboratory, New Delhi.
Sinha, M. P., Manurial Tables Scheme, Bihar, Salimpore Ahara, Kadamkuan P.O., Patna-3.
Sinha, (Miss) Suchhanda, 15/1, Ramkanto Bose Street, Calcutta-3.
Shenolikar, I. S., B.Sc. (Hons.), Dept. of Chemistry, Karnatak University, Dharwar.
Som, K. C., Dept. of Metallurgy, Bengal Engineering College, Botanic Garden, Howrah.
Sonar, V. G., Chemistry Department, Willingdon College, Vishrambag, Sangli.
Srinivasan, C., Research Scholar in Botany, Annamalai University, Annamalaiagar.
Subbiah, B. V., Division of Chemistry, Indian Agriculture Research Institute, New Delhi-2.
Sunwal, P. N., C/o. Dr. S. P. Pathak, Dept. of Industrial Chemistry, Hindu University, Banaras.

T

- Talapatra**, Sunil Kumar, Pure Chemistry Dept., Science College, 92, Upper Circular Road, Calcutta-9.
Tandon, J. N., Research Chemist, H. B. Technological Institute, Kanpur.
Thaker, Rajnikant Hariprasad, Dudhia Building, Amlini Pole, Raipur, Ahmedabad.
Tikoo, P. K., C/o. Dr. S. S. Joshi, Principal, College of Science, Hindu University, Banaras.
Tikotkar, N. L., Chemistry Dept., Karnatak University, Dharwar.
Tiwari, K. J., C/o. Shri S. B. Pandit, Workshop Engineer, Alembic Chemical Works, Baroda-3.
Thiagarajan, T. R., Research Scholar, Dept. of Biochemistry, Indian Institute of Science, Bangalore-3†
Trivedi, H. R., Dept. of Sociology, Faculty of Arts, M. S. University, Baroda.

V

- Vaish**, S. K., Nutrition Division, Indian Veterinary Research Institute, Izatnagar.
Vishnu, M.Sc., Research Scholar, Indian Institute of Sugar Technology, Kanpur.
Viswanathan, T. N., Applied Chemistry Section, Indian Institute of Technology, Kharagpore.
Voghani (Miss) D. D., Organic Research Laboratories, Institute of Science, Mayo Road, Fort, Bombay.

W

- Wad**, J. K., Chemistry Dept., Wilson College, Bombay.
Wadha, Y. D., Dept. of Mathematics, Indian Institute of Technology, Kharagpore.

X

- Xavier**, J., Dept. of Inorganic Chemistry, Indian Association for the Cultivation of Science, Jadavpur, Calcutta-32.

Z

- Zaidi**, S. T. H., Research Chemist, H. B. Technological Institute, Kanpur.

MEMBERS WITHOUT VOTING RIGHT ENROLLED AT BARODA

A

Anjor, S. Narayan, Lecturer, Science College, Raipur.

B

Bhatia, Baldes, College of Nursing, 12, Jaspantsingh Road, New Delhi.
Brhmachari, Miss C., 19, Loudon Street, Calcutta.

C

Cardmaster, Mecnu P., Ewert House, Burce Street, Bombay.
Chari, S. A., C.S.I.R., New Delhi.
Chari, S. S., C/o. Tata Chemical Ltd., Mithapur.

D

Dabey, Dr. C. P., Fisheries Development Officer, Madhyabharat, Gwalior.
Deokar, V. L., Baroda Museum, Baroda
Deshpande, Prof. D. S., B. J. Medical College, Ahmedabad.
Desai, Upendra D., Physics Research Laboratory, Nawarangpur, Ahmedabad.
Dutta, Devbrata, C/o. Chemical Plant & Equipment Ltd., 7, Lower Chitpur Road, II Floor, Calcutta.

G

George, E. C., Tata Institute of Fundamental Research, Bombay.

K

Kale, Laxman W., Supdt. Engineer, P.W.D., Bhadra, Ahmedabad.
Kundu, Himansu, 575, Dr. Sarat Chatterjee Road, P.O. Santrachi, Howrah.
Kotadia, K. M., Physical Research Laboratory, Ahmedabad.
Kotibhaskar, M. G., Krishna Kamal, Gokhale Road, (North), Bombay-28.
Krishnan, Dr. G., Reader in Zoology, Madras University, Madras.

M

Maiti, Prof. H. P., B. M. Institute of Child Development, Ahmedabad.
Mehta, B. V., 552, A. H. Adenwalal Road, Bombay-19.
Mehta, Bhapetrai Shivashanker, Sewage Chemist, Municipal Corporation, 1872/3, Mota Sutarwada's Pole, Khadi.
Mehrotra, B.S., University of Allahabad, Allahabad.
Mitra, Mrs. Gita, 326/A, Chittaranjan Avenue, Calcutta.
Mohapatra, G. N., C/o. N. C. Das, Ship Hotel, 219, Feroj Road, Bombay.
Murthi, H. S. N., Secretary, Association of Scientific Workers, O. E. Joglekar Quarters, Poona-4.

N

Nair, A. P. Madhavan, A. C. College of Technology, Madras-25.
Narshianhan, Prof. K. L., 1176, Ambawadi, Bhavnagar.

P

- Pal**, Dr. A. K., C/o. Atriya Physiology, Allahabad-9.
Parmeswaran, P. R., Philips Electric Co. (India) Ltd., Tata Road, Bombay.
Patel, Khushalbhai H., Consulting Chemical Engineer, Khenwadi, Kandivali Village, Bombay.
Pillai, K. S. Madhvan, Research Officer, Central Research Institute, University of Travancore, Trivendrum.
Prakesh, Dr. Rani, Bhopal.
Prasad, R. N., Lecturer in Chemistry, B. N. College, Patna.

R

- Raina**, A. N., Jammu & Kashmir University, Shrinagar.
Raina, Arjun N., Jammu & Kashmir University, Shrinagar.
Rajagopalan, R., C/o. Martiss & Horn Ltd., Bombay.
Rao, C. N. A., Jupiter Mills Ltd., Ahmedabad.
Rathi, Dr. R. J., C/o. Messrs. Amritlal & Co., Ltd., Ballard Estate, Bombay.
Roy, S. K., B.E.E., C/o. Messrs. Philip Electrical Co. (India), Ltd., Calcutta.

S

- Santhappa**, M., C/o. University of Madras, Madras.
Saxena, Dr., Botany Dept., Osmania University, Hyderabad.
Shah, C. C., Wadgi Road, Ahmedabad.
Shah, Dr. C. S., 6, Bharti Society, Ellise Bridge, Ahmedabad.
Shah, U. P., Vin Vir Corporation, 87, Fardes Road, Bombay-7.
Shah, R. P., Dalapatle's Pole, Baroda.
Sehagal, B. R., Asst. Director, Terriiff Commission, Bombay-1.
Siddique, Dr. Jamil Ahmad, Muslim University, Aligarh.
Soni, Harikrishna H., Sanitax, Baroda.
Sreenivasan, Research Asst., Fisheries Technological Section, Kozhi Kode.
Surati, B. M., Ahmedabad, Bhoiwad.
Swaminathan, S., C/o. University of Madras, Madras.

T

- Thosare**, V. B., Assistant Director of Industry (Chemicals), Industries Research Laboratory, Dept. of Industries, Bombay-19.

U

- University of Roorkee**, The Registrar, Roorkee.
Uttamchan, (Dr.), Indian Council of Agriculture, Mansing Road, New Delhi.

V

- Vankatrao**, Prof. C., Head of the Department of Chemical Technology, Andhra University, Waltair.
Venketeswaram, Kunapuli, Annammali University, Annamalinagar.
Vednathan, S., New Delhi.

W

- Watcha**, Mrs. Feroja F., Tata's Saija Colliery, P.O. Sajina, Bihar.
Wahi, Premnath, Medical College, Agra.

SESSIONAL MEMBERS ENROLLED AT BARODA

A

Agarwal, K. L., Forest Research Institute, Dehra Dun.
 Ajwani, R. H., Pratap Bungalow, Warshia, Baroda.
 Amble, V. N., Delhi.
 Anandrao, T., Lecturer in Botany, Gujrat College, Ahmedabad-6.
 Arphonse, Bombay.
 Ashwin, Dr. James, Cristian Medical College, Punjab.
 Asnani, G. C., Vidyathri Boarding House, Baroda.

B

Banerjee, K. B., 5, Dalhousie Sq., Calcutta.
 Banerjee, M., Tangra 2, 2nd Lane, Calcutta-15.
 Banerjee, S., C/o. M/s. D. Nanubhai & Co., Raopura, Baroda.
 Banerjee, Dr. S. L., C/o. Shri B. Pant, C.W.N.C. P.O., 18, Poona-1.
 Basek, N. G., P.O. Jealogra, Bihar.
 Baslas, Dr. K. K., Chemistry Dept., Agra College, Agra.
 Baveja, B. K., Asst. Geologist, Geological Survey of India, 27, Chowringhee Road, Calcutta.
 Bawa, Dr. S. R., Punjab University, Hoshiarpur.
 Beslas, K. K., Agra College, Agra.
 Bhatia, D. S., Sc D. (M.I.P.), Head Dnl. Food-processing, Central Food Technological Research Institute, Cheluanba Mension, V. V. Mohalla, P.O. Mysore.
 Bhatia, N. S., 43, Pratap Gunj, Baroda.
 Bhatt, V. L., M. G. Science Institute, Amhedabad.
 Bhatnagar, R. K., S. K. B. Hindu Colony, Dadar, Bombay.
 Bhatnagar, R. S., 6268/26/2, Nicklson Road, Ambala.
 Bhaskaran, M., M. G. M. Medical College, Indore.
 Bhavsar, H. S., M.Sc., Head of the Physics Department, Petlad College, Petlad.
 Bhide, G. K., Gujrat College, Ahmedabad.
 Bhole, S. W., C/o. Mr. Korade Jambu Bet, Baroda.
 Biswas, Dr. S., C/o. A. V. Sathe's Bungalow, Dhantoli, Nagpur.

C

Chakrabarty, R. N., Js.A., 63, Govindappa Road, Bangalore-4.
 Chambey, Shambhai Dayal, Madhav College, Ujjain.
 Chanbalkar, V. W., Ram Bag, Baroda.
 Chandra, Ram, Workshop Ambala.
 Chandras, K. S., B. S. D. W. Rly., Dyisar.
 Chatterjee, N. G., Calcutta.
 Chavan, Prof. J. G., Vallabh Vidyanagar, Anand.
 Chavan, J., Hathi Pole, Baroda.
 Chinmayanandam, B. R., 63, Govindappa Road, Bangalore-4.
 Chitle, Ashok G., Navrangpur, Ahmedabad.
 Chokshi, K. N., J.N.J. College of Science, Nadiad.
 Choudhari, Dr. S., Sure Road, Bombay.
 Choudhury, Prof. D. H., M. G. College, Jalgaon, E.U.
 Chouthoy, Ahmedabad Textile Research Association, Ahmedabad.

D

- De, Dr. H. N., M. G. M. Medical College, Indore.
 Delvadi, N. C., Deputy Engineer, Saroj Bungalow, Baroda.
 Deokar, Mrs. V. L., Baroda Museum, Baroda.
 Deshpande, P. V., C/o. A. V. Sathe's Bungalow, Dhantoli, Nagpur.
 Deshpande, S. R., 43, Pratap Gunj, Baroda.
 Desai, A. S., Jyoti Ltd., Baroda.
 Desai, Anilkumar S., C/o. M. G. Vaishnav Engineer, Gunda Falia, Palace Road, Baroda.
 Desai, B. N., M. G. Science Institute, Ahmedabad.
 Desai, Dr. C. M., Ambaram Niwas, Nanpura, Surat.
 Desai, M. B., Kesler Sugar Works, Bombay.
 Desai, H. S., Raopura Road, Opp. Kothi Office, Baroda.
 Desai, Harendra Savaklal, Himalaya Drug Co., Maganwadi, Sayaji Gunj, Baroda.
 Desai, U. D., C/o. D. H. Patel, Physical Research Laboratory, Navarangpura, Ahmedabad.
 Desai, M. D., M. Deuskar, Mahatma Gandhi Road, Baroda.
 Desai, Sudhir S., Oza Building, 2nd Floor, Salatwada, Baroda.
 Dill, Ajit Singh, Insdoc, N. P. L., New Delhi.
 Divatia, A. S., Atira, Ahmedabad.
 Dalal, Indra J., Sayaji Gunj, Baroda.
 Das, B. N., National Metallurgical Laboratory, Jamshedpur.
 Das, T. B., Institute of Nuclear Physics, University College of Science 92, Upper Circular Road, Calcutta-9.
 Dave, M. M., Demonstrator in Botany, Gujarat College, Ahmedabad.

E

- Ellies, Wade, Professor of Mathematics, 168, Goldlink Area, New Delhi.
 Ellur, B. V., K. E. B.'s College, Dharwar.

G

- Gadgil, Neelkant Ramchandra, 305, Hornby Road, Bombay.
 Gaitonde, N. S., Nair Hospital, Lemington Road, Bombay-8.
 Gandhi, S. N., Desai Sheri, Ghandiali Pole, Baroda.
 Ganapathy, N. Seetha N., St. G. S. Medical College, Bombay.
 Gangoly, Mukulprakesh, 9, Nalin Serker Street, Calcutta-4.
 Garge, Pulin K., B. M. Institute of Child Development, Ahmedabad.
 Gaurang, Desai, S. Raopura, Baroda.
 George, A. I., Asst. Director of Fisheries (Mangalore), Madras.
 George, Dr. E. J., Trivendrum.
 Gore, Ushakant, R., Faculty of Home Science, Baroda.
 Ghosh, R. S., S. L. A., 63, Govindappa Road, Bangalore-4.
 Gill, Dr. J. S., Planning Commission, New Delhi.
 Godambe, Bureau of Economics & Statistics, Govt. of Bombay, Yatch Club, Appollo Pier, Bombay-1.
 Godbole, R. D., 250, Sadeshiv Peth, Poona.
 Gokhle, N. L., C/o. Shri Dhoble, Dhanotoli, Nagpur.
 Gupta, R. S., Praful Nivas, Pratap Gunj, Baroda.
 Gupta, Miss Vimala, B. M. Institute of Child Development, Ahmedabad.
 Gunapathy, C. V., New Delhi-12.

H

Hafeez, A., 2904, Saraswatipuram, Mysore.

Homi, M. M., Navasari.

J

Jaiswal, G. P., Lecturer in Zoology, College of Science, Usmania University, Hyderabad.

Jatkar, Dr. V. D., Arvinda Hall, Animal & Husbandry College, Usmania University, Hyderabad.

Joshi, Dr. A. B., India Agricultural Laboratory Institute, New Delhi.

Joshi, Bhanuprasad M., 20, Rambangh Maninagar, Ahmedabad.

Joshi, P. P., Poona University, Poona.

Joshi, S. S., Ph.D., Professor of Physics, Bahaddur College, Junagarh.

K

Kamat, N. D., M.Sc., Lecturer in Botany, Gujrat College, Ahmedabad-6.

Kanbi, H. K., Pratap Gunj, Baroda.

Kane, J. G., Dept. of Chemistry, Tech., Bombay-9.

Kapuskar, A. T., M.Sc., C/o. Shri Marathe Ramdas Pathe, Nagpur.

Karbhari, S. S., C/o. Sumat Patel, Jogidas V. Pale, Baroda.

Katra, Miss Mira, Shri Nadkerni, Pratapnagar, Baroda.

Kar, Bepin Chandra, Jemshedpur-7.

Kazi, Dr. (Miss), Ambaram Niwas, Nanpura, Surat.

Kedare, B. S., University of Bombay, Bombay.

Khan, Nawab Hasan, Aligarh University, Aligarh.

Khorana, Manharlal, Reader in Pharmachemistry, Dept. of Chemical Technology, Mantunga, Bombay.

Khot, G. K., Navcheitanya Khat Compound, Dharwar.

Kothari, Chhotalal J., 210-A, Vinant Road, Matunga, Bombay.

Kothari, R. A., Rambag, Baroda.

Kotnis, M. S., Chemist, Shantacruz, Bombay.

Krishana, H. J. V., National Chemical Laboratory, Poona.

Krishnaya, P. Govinda, Dept. of Atomic Energy, Bombay.

Kulkarni, A. B., L. D. Engineering College, Ahmedabad.

Kunjkar, Miss M. N., Institute of Science, Bombay.

M

Mahajan, M. D., 318, Dalles Building, Room No. 4, Dadai.

Majumdar, G. K., M.A., Technological Asst., National Atlas of India Dept. of Geography, Senate House, Calcutta University, Calcutta.

Majumdar, J. D., Gantiada, Baroda.

Majumdar, Janendra N., Gealgora, Bihar.

Majumdar, S. K., Js.A.F.R.I., 63, Govindappa Road, Bangalore-4.

Malik, V. Dutt, Govt. Medical College, Patiala, Pepsu.

Malik, Wahid U., Muslim University, Aligarh.

Mapera, R. K., Lecturer in Chemistry, M. T. B. College, Surat.

Marthy, M. H. S., Professor of Biology, Dharmendra College, Rajkot.

Mathur, U. B., Statistics Officer, Raj Government, Jaipur.

Mathur, S. C., C/o. A. V. Sathe's Bungalow, Dhantoli, Nagpur.

Mehta, Dr. C. M., Lecturer in Faculty of Science, Baroda.
Mehta, Dr. Priyavadan C., Atira, Ahmedabad.
Merotra, C. G., 34, Alembic Colony, Baroda.
Miller, Sm. Manjari, C/o. Shri G. C. Miller, F. W. I. Master Eassy Dept., and Silver Refinery Project, Calcutta.
Mistry, J. T., Sure Road, Bombay.
Mohinuddin, S. G., Lecturer, G. T. College, Hyderabad.
Munshi, Miss Terani R, Oza Building, 2nd Floor, Salatwada, Baroda.
Mukherjee, A., C/o. A. V. Sathe's Bungalow, Dhantoli, Nagpur.
Moitra, A. K., S.S.A.F.R.I., 63, Govindappa Road, Bangalore-4.

N

Nadhl, H., Mohan Bunglow, Baroda.
Nadkerni, Pratapnagar, Housing Colony, Baroda.
Naik, Dr. A. R., Krishna Nivas, Bhutdi Zampa, Baroda.
Naik, A. R., Atul Products Ltd., Atul Via Bulsar.
Nande, Prof. H. R, G. G. M. Science College, Jammu.
Nandi, S. P., Js.A F.R.I., 63, Govindappa Road, Bangalore-4.

O

Pahade, M. G, C/o. Prof. J. S. Pahade, Tulsi Bag Road, Circle No. 3, Nagpur.
Panday, J. B., National Chemical Laboratory, Poona.
Pande, Saroj, Institute of Science, Bombay.
Pandit, Dr. H. G., College of Agriculture, Poona.
Paul, Dr. Ram Chand, Punjab University, Hoshiarpur.
Pathak, C. H., C/o. A. D. Muley, Baroda.
Pathak, P. D., Professor of Physics, L. D. Arts College, and M. G. Science Institute, Ahmedabad.
Pathak, P. N., M. G. M. Medical College, Indore.
Pathak, M. S., Oadra.
Pathak, V. B., 114, Pratap Gunj, Baroda.
Patel, B. P., Naveb Mahal, Raopura, Baroda.
Patel, Bhailalbhai Motibhai, 68, Bajaj Road, Ville-Parle (West), Bombay-24.
Patel, Dr. B. G., 54, Alkapuri, Baroda.
Patel, B. C., Kothi Pole, Baroda.
Patel, M. M., 54, Alkapuri, Baroda.
Patel, N. M., 25, Alkapuri, Baroda.
Patel, J. G., Krishna Nivas, Bhutadi Zampa, Baroda.
Patel, C. J., Sayaji Gunj, Baroda.
Patel, S. V., 25, Alkapuri, Baroda.
Patel, Dhayabhai G., Sarma Fire Works, Harni Road, Baroda.
Patel, Ramanlal C., Garden Supdt., Govt. Gardens, North Division, Baroda.
Patel, P. R., Bajwada, Baroda.
Patel, C. J., Sayaji Gunj, Baroda.
Patel, H. R., Indian Chemical House, Raopura, Baroda.
Patel, Miss H. R., Krishna Nivas, Baroda.
Patel, Ranchhodlal A., Mama's Pole, Baroda.
Patel, S. C., C/o. Sumat Patel, Jogidas V. Pale, Baroda.
Patel, S. M., Naulakha Haveli, Ladwada, Baroda.
Patel, Miss H. R., C/o. M. L. Bhatt, Sayaji High School, Baroda.
Patel, N. C., Karamsad, Anand.

- Patel, M. C.**, Nagarwada, Baroda.
Patel, H. M., Naulakha Haveli, Ladwada, Baroda.
Patel, J. S., Kabir Nivas, Jubeeli Garden, Baroda.
Patel, M. M., Sultanpura, Baroda.
Patel, M. J., Jyoti Ltd., Baroda.
Patel, J. B., Mama's Pole, Baroda.
Patel, Raojibhai, C/o. Santaben Chimanlal Patel, Near Devaram Factory, Salat Wada, Baroda.
Pawaohar, A., Dandia Bazar, Baroda.
Patwardhan, S. D., Maharashtra Association for the Cultivation of Science, Law College, Poona.
Phadte, Varan Shander, 305, Hornby Road, Bombay.
Pliai, N. B., Chaitanya Dham, Baroda.
Poddar, R. K., Institute of Nuclear Physics, 92, Upper Circular Road, Calcutta.
Potnis, B. G., Punjab National Bank, Baroda.
Prabhu, M. S., Research Laboratory, Madras.
Pradhan, C. N., Jyoti Ltd., Baroda.
Prakesh, Ved, G. G. M. Science College, Jammu.
Pralad, S. Hamgal, Technical Administrator, Neeli Bunglow, Hubli.
Prati, Miss Padma, C/o. Prof. of Zoology, Central College, Bangalore.
Parikh, M. H., Gandigate Road opp. Ghantida, Baroda.
Parikh, N. C., C/o. Wadilal Sarabhai Hospital-Ellise Bridge, Ahmedabad-6.
Parikh, Ochhavlal M., Sankhoda.
Parimo, M. L., G. G. M. Science College, Jammu.
Premandadas, Maharshi Arvind Hall, Baroda.
Puri, Prof. B. D., M.A., Council of Scientific & Industrial Research, New Delhi.
Pruthi, J. S., Central Fruit Technological Research Institute, V. V. Mohalla P.O., Mysore.
Puri, D. D., National Physical Laboratory, New Delhi.
Puri, V. D., G. G. M. Science College, Jammu.
Purshottam, A., Andhra University, Waltair.

R

- Raina, C. L.**, C/o. P. K. Jadhav, Pratap Road, Baroda.
Rajan, V. S. Govind, National Chemical Laboratory, Poona.
Rajani, T. C., 27, Babugem Road, Bombay.
Ramchandra, Pathak Satish, Bajwada, Bhatiasheri, Baroda.
Rangarajan, S., Astrophysical Laboratory, Kodaikanal.
Raman, R., Plot 22, Magalwad Peth, Poona-2.
Ramanna, R., Dept. of Atomic Energy, Bombay.
Rangneker, Dr. Y. B., Professor of Chemical M. B. Agri. College, Gwalior.
Ramanner, Dr. R., C/o. A. V. Sathe's Bungalow, Dhantali, Nagpur.
Ramanlal, Shukla Padmansabh, Ahmedabadi Pole, Baroda.
Rao, Dr. B. K., 281, Checkal, Pathi-Hyderabad.
Rao, Dr. B. Sunder Ram, Reader, Dept. of Geography & Physics, Andhra University, Waltair.
Rao, Dr. K. S., Dept. of Statistics, Bombay University, Bombay.
Rao, Dr. U. R., Physical Research Laboratory, Ahmedabad.
Rastogy, Dr. R. P., Dept. of Chemistry, Lucknow University, Lucknow.
Razdam, Raj K., National Chemical Laboratory, Poona.
Reed, Dr. Mary Frances, Visiting Professor of Home Science, Baroda.
Roy, D., Institute of Nuclear Physics, 92, Upper Circular Road, Calcutta-9.
Reddy, Ashok K., Khadia Pole, Baroda.

S

- Sachdeo**, Dr. J., M. G. M. College, Indire.
Sadalia, Dr. B. M., C/o. Havji Thoria, 576, Manel Villa, Bombay.
Sahaya, Prem Nandan, C/o. V. C. Patna University, Patna.
Salperher, Vasydeo Sitaram, Sarabhai Chemicals, Baroda.
Sammel, D. Y., M.Sc., Universal Scientific Co., 32, Parekh Street, Bombay-4.
Sandil, J. B., Bhavnagar.
Sareen, Dr. K. N., Dept. of Pharmacology, Medical College, Amritsar.
Satyapel, M., Planning Commission, Dharbhanga House, New Delhi.
Sauhney, Prof. R., G. G. M. Science College, Jammu.
Savarhar, H. S., B.Sc., C/o. Radio Lamp Works Ltd., Laboratory Apparatus Works, 47/21, Law College, Poona-4.
Sengupta, Narendra Nath, P.O. Gealgora, Bihar.
Sengupta, S., C/o. D. Nanubhai & Co., Raopura, Baroda.
Sen, S. N., C/o. Calcutta Chemical Co. Ltd., Calcutta-29.
Sengkari, H. B., Opp. Khanderao Market, Baroda.
Seshadri, T. R., Central College, Bangalore.
Seth, S. K., Doctor's Dibi, N. P. 2, New Delhi.
Sewasing, Dr., Demonstrator, Medical College, Amritsar.
Sexna, M. R., Usmania University, Hyderabad-Dn.
Shah, Padmakant R., Baroda.
Shah, S. C., Baroda.
Shah, N. T., Bajwada, Baroda.
Shah, R. S., Hayaji Gunj, Baroda.
Shah, R. M., Desai Sheri, Ghadiali Pole, Baroda.
Shah, C. S., Punjab University, Hoshiarpur.
Shah, A. K., Baroda.
Shah, R. P., Bombay-1.
Shah, Ambalal C., Kadwaseri, Ahmedabadi, Baroda.
Shah, Miss J. B., C/o. M. L. Bhatt, Sayaji High School, Baroda.
Shah, B. N., Ahmedawadi Pole, Baroda.
Shah, A. C., Liplasher, Baroda.
Shah, Jantilal N., Narsinhji's Pole, Baroda.
Shah, K. N., Narsinhji's Pole, Baroda.
Shah, B. G., Animal Nutrition, Institute of Agriculture, Anand.
Shah, Ratanlal, Kadwaseri, Ahmedabadi, Baroda.
Sharma, Baneri Das, Oriental Apparatus.
Sharma, R. S., G. G. M. Science College, Jammu.
Shastri, B. N., M.Sc., A.R.I.C., A.I.I.Sc., Editor of Ex-Officio, Secretary, Journal of Science Research, Council of Scientific & Industrial Research, New Delhi.
Sheth, Netwarlal G., Pratap Gunj, Baroda.
Shorah, H. M., G. G. M. Science College, Jammu.
Shroff, Miss Leena, Bangalore-3.
Shrinivas, K. S., Baroda.
Shrinivasan, T. P., C/o. A. V. Sathe's Bungalow, Dhantoli, Nagpur.
Shukla, Rasiklal T., Maharana Bhopal College, Udaipur.
Sigbal, B. V., C/o. A. V. Sathe's Bungalow, Dhantoli, Nagpur.
Singh, D. P., G. G. M. Science College, Jammu.
Singh, Ram Shankar, Dalmianagar, Dist. Shahabad, Bihar.
Srinivasan, S. R., Physical Research Laboratory, Ahmedabad.
Srinivasan, V. R., Usmania University, Hyderabad-Dn.
Subbarao, M. K., Plant Pathologist, C/o. Chita Ltd., Bombay.
Subbarama, P. R., National Chemical Laboratory, Poona.

- Subramaniam, N.**, Central Fruit Technological Research Institute, V. V. Mohalla P.O., Mysore.
Subnis, D. D., 5, Pradhan Building, Akshikar Street, Dadar.
Swaminathan, M., D.Sc., Central Fruit Technological Research Institute, V. V. Mohalla P.O., Mysore.

T

- Takkar, J. D.**, Lokhandawala Chaul, Sayaji Gunj, Baroda.
Teddington Chemical Factory Ltd., Rure Road, Bombay.
Tata Oil Mill Co., Sweari Mills.
Tilak, Maduri V., Dandia Bazar, Baroda.
Trivedi, D. M., Technical Chemist, Plot No. 587, Bombay.
Trivedi, Harshad M., B.Sc , Anand Bag, Tagore Road, Shantacruz, Bombay.
Trivedi, P. C., G. B Road, Shantacruz, Bombay.
Trivedi, S. S., Atira, Ahmedabad
Trivedi, Y. R., L. D. Engineering College, Ahmedabad.
Tyanger, R. K. N., Delhi.
Tyengar, P. K, C/o. A. V. Sathe's Bungalow, Dhantoli, Nagpur.

U

- Udupa, Dr. H. V. K.**, Senior Scientific Officer, Electrical Chemical Research Institute, Alagappa College, Karaikudi.
Ullah, Dr. Habil. Chief Chemist, Drugs Research Laboratory, Kashmir.
Uppal, H. L., New Delhi.
Upadhyay, H. D., Demonstrator, M. T. B. College, Surat.

V

- Vabbiz, Mrs Shrooff**, 68, Bajaj Road, Ville-Parle (West), Bombay-24.
Vedanthan, S., Doctor's Dibi, N. P. 2, New Delhi.
Venkateshwar, K. S., Andhra University, Waltair.
Verma, M. R., New Delhi.
Veeraghavan, N., C/o. A. V. Sathe's Bungalow, Dhantoli, Nagpur.
Vora, Dr. K. G., C/o. A. V. Sathe's Bungalow, Dhantoli, Nagpur.
Vinod, Miss Vimal R., Salatwada, Baroda.
Vishwashwarier, C/o. The Residence Engineer, Power House, Nagpur.

W

- Wakharikar, Miss Suman G.**, Palace Road, Suratkar Cali, Baroda.
Work, William H., Nagpur.

Y

- Yardi, S. R.**, Sarabhai Chemicals, Wadi-Wadi, Baroda.

STUDENT MEMBERS ENROLLED AT BARODA

A

Ahluwalia, Harjit Singh, C/o. D. H. Patel, Physical Research Laboratory,
Navarangpur, Ahmedabad.
Ajila, K. Y., Karnatak University, Dharwar.

B

Barramn, P. A. D., Madras University, Madras.
Basu, Amita, 39, Narkeldanga Main Road, Calcutta-11.
Besavrajappa, K. G., Karnatak University, Dharwar.
Bhat, B. R., Karnatak University, Dharwar.
Bhatt, Pravinsagar J., C/o. M. D. Purohit, Sayaji Gunj, Baroda.
Bhat, Dr. S. G., Dyes Research Sec., Dept. of Chemical Technology, Bombay.
Bhattacharya, Nalin, Organic Dept., Indian Association for the Cultivation of
Science, Calcutta-32.

C

Chandrashankar, C. V., Banaras Hindu University, Banaras.
Chowla, Awatar Singh, I.C.A.R., New Delhi.
Chaturvedi, S. C., Madhav College, Ujjain.
Chaurishia, J. L., Madhav College, Ujjain.
Chimandas, Bhagat Shambhai, Shastri Pole, Baroda.
Chokey, L. K., Madhav College, Ujjain.
Chokshi, Indravandan H., Mehta Pole, Baroda.
Choula, H., I.C.A.R., New Delhi.

D

Dattraram, Dharmani Ishwar, Baroda.
Deir, Dharm, A. S. College, Shrinagar.
Desai, J. C., Chauokhandi Gate, Baroda.
Desai, R. G., St. Electrical Engineering Faculty of Technology, Baroda.
Devetia, Uday, C/o. Victoria College, Gwalior.
Dey, Shishirkumar, St. Xavier's College, 30, Park Street, Calcutta.

G

George, P. P., Karnatak University, Dharwar.
Ghosh, Pradipkumar, University College of Science, Physiology Dept., 92, Upper
Circular Road, Calcutta.
Gidnandi, S. R., Karnatak University, Dharwar.
Gurunath, K. S., Karnatak University, Dharwar.
Gopalan, A., Madras University, Madras.
Gupta, S. R., Madhav College, Ujjain.
Gupta, T. K., I.C.A.R., New Delhi.

H

Hameed, Shagul, Madras University, Madras.

I

Indrajit, A. S. College, Shrinagar.

J

Jacob, K. J., Banaras Hindu University, Banaras.

Jagtapa, Madhav College, Ujjain.

Jeljaia, Nathani Nathum, Panigate, above Rationing Shop, Baroda.

K

Kale, P. S., Madhav College, Ujjain.

Kapadia, G. G., 119, Dadyseth Agiary Lane, Bombay 2.

Kapadia, G. T., 119, Dadyseth Agiary Lane, Bombay-2.

Kapoor, Kalash, A. S. College, Shrinagar.

Khan, R., A. S. College, Shrinagar.

Khanna, R. C., T. C. A. R., New Delhi.

Krishnamurthy, Madras University, Madras.

Kumar, Hardarshan, M.Sc., Botany Department, Banaras Hindu University, Banaras.

Kumar, Kanti, A. S. College, Shrinagar.

L

Lal, M. M., I.C.A.R., New Delhi.

M

Malali, H. C., Karnatak University, Dharwar.

Mastaffa, A. S. College, Shrinagar.

Mitbandar, Dr. V. B., Dyes Research Section, Dept. of Chemical Technology, Bombay-9.

Mitra, Miss Raju, C/o. Prof. A. T. Mitra, L. S. College, Muzaffarpur.

Mitra, Dr. R. B., Dyes Research Section, Dept. of Chemical Technology, Bombay-9.

Murthy, K. S. Q., Karnatak University, Dharwar.

N

Nilkanth, K., I.C.A.R., New Delhi.

Ninan, V. I., Karnatak University, Dharwar.

P

Patel, Dilipkumar, Ahmdavadi Pole, Baroda.

Patel, K. R., Limda Pole, Baroda.

Patel, Manubhai Motibhai, Tara Nivas, Baroda.

Patel, Umedbbai R., Institute of Agriculture, Anand.

Palil, G. P., Daxima Fellow, Poona University Hostel, Poona.

Parchure, M. N., I.C.A.R., New Delhi.

Perouz, A. S. College, Shrinagar.

Prakash, Satya, C/o. Dr. H. Patel, Physical Research Laboratory, Navarangpur, Ahmedabad.

R

- Raj, G. B., St. of Faculty of Arts, Baroda.
 Raj, V. R., Faculty of Science, Baroda.
 Rajan, A. C. Sunder, Madras University, Madras.
 Ramchandra, A., Madras University, Madras.
 Ramachandrarao, U., C/o. D. H. Patel, Physical Research Laboratory, Navarangpur, Ahmedabad.
 Ramji, Shankaran, C/o. Victoria College, Gwalior.
 Ramswami, C. R., Madras University, Madras.
 Rangachary, Mudumbisri, Broach Hostel, Banaras Hindu University, Banaras.
 Ranganna, M. S. Karnatak University, Dharwar.
 Rao, A. N. Yogendra, Karnatak University, Dharwar.
 Raon, V. H., Madras University, Madras.
 Rastogy, R. G., C/o. D. H. Patel, Physical Research Laboratory, Navarangpur, Ahmedabad.
 Rege, Dr. D. V., Dyes Research Section, Dept. of Chemical Technology, Bombay-9.
 Rizai, Tanwerali, Madhav College, Ujjain.
 Rudwal, S. C., Madhav College, Ujjain.
 Ruptmara, Chandvani, B319-10, Warsia Colony, Baroda.

S

- Sant, Suresh M., Akanxa Boarding, Behind Santa Devi Talkies, Baroda.
 Saraia, Narendra A., C/o. Arvindlal M. Kalpana, Pirmitar Road, Baroda.
 Sarker, R. Partha, Madras University, Madras.
 Serkar, Tapas Kumar, St. Xavier's College, 30, Park Street, Calcutta.
 Shah, Jagdish Kanialal, Mehta Pole, Baroda.
 Shah, Surendra, Madhav College, Ujjain.
 Sharma, B. K., Madhav College, Ujjain.
 Shashtri, J. D., St. Electrical Engineering Faculty of Technology, Baroda.
 Shreenivasrao, Palur, Banaras Hindu University, Banaras.
 Singh, Mohinder, A. S. College, Shrinagar.
 Singh, Rajkumar, I.C.A.R., New Delhi.
 Singhal, M. P., Madhav College, Ujjain.
 Som, Panchanan, 5, Tilebatibaba Lane, Chakruturia, Howrah.
 Srikhande, V. J., I.C.A.R., New Delhi.
 Subbarao, D. V., Karnatak University, Dharmar.

T

- Tahasildar, A. H., Karnatak University, Dharwar.
 Telagy, S. H., Karnatak University, Dharwar.
 Tocklai Experimental Station, The Director, Cinnamara P.O., Assam.
 Trivedi, Anand Prakash, 103, R. K. Hostel, Banaras Hindu University, Banaras.

U

- Upadhyaya, M. P., I.C.A.R., New Delhi.

V

- Vaidya, Madhukar, Gopal, 36, Goodwill Assurance Building, Bombay-16.
 Vashi, Ramesh M., Student of Engineering College, Akanksha Boarding, Behind Santa Devi Talies, Baroda.

Venkataraman, K., Madras University, Madras.

Vidya, Srinivas M., University of Poona, Poona.

Vohra, Miss Sheela, St. of Faculty of Arts, Baroda.

W

Wagle, Haffkin Institute, Bombay.

Y

Yasin, A. S. College, Shrinagar.

INDEX

A

Absolute Summability of Series, IV, 24.

Aga, Ashma and M. R. A. Rao, The adsorption of gases on metal powders at low Milk pool for the Haryana Breed, III, 342.

Agarwala, B. D., Singularly Loaded Rectilinear Plates, III, 10.

Agarwal, K. C. and M. R. Verma, Estimation of Boric acid in Nickel-plating Baths, III, 80.

Agarkar, P. S., G. V. Chiplonkar and K. C. Dubey, A Preliminary Note on the Petrography of the area around Jhansi, III, 186.

Agarwal, K. K., S. S. Sarkar and Usha Deka, Brachycephaly in India, III, 319.

Agarwal, Y. K., Euryte dykes in the metamorphics around Jharia coalfield, III, 201.

Agarwal, Y. K., and M. S. Sadashivah, A Note on the origin of Cordierite-bearing and other Vitrophyric and Horafelsic rocks of Chasnala area, Jharia Coalfield, III, 203.

Ahmad, B. A. Gulam and M. Appaswamy Rao, Histological changes of the thymus of *Loris lydekkerianus* (Fabr.), III, 309.

Ahmad, F., The Gondwana Basin of Sedimentation in India, III, 177.

Ahuja, L. D. and A. N. Gutam, A Study of Variation in Butter fat content of a Herd temperatures, III, 110.

Aiya, S. V. Chandrashekhar and C. G. Khot, Atmospheric Noise level in the 1 Mc/s Band at Poona, III, 422.

Aiya, S. V. Chandrashekhar and R. D. Joshi, Field strengths of fading signals in the Tropical Short Wave Broadcast Bands, III, 422.

Aiya, S. V. Chandrashekhar and C. K. Sane, Atmospheric Noise level in the 10 Mc/s Band at Poona, III, 422.

Aiya, S. V. Chandrashekhar and K. R. Phadke, Atmospheric Noise Level in the 5 Mc/s Band at Poona, III, 421.

Ajmani, Balraj and A. N. Saha, Studies in Wrinkle Finishes. Part I, III, 148.

Ali, M. A., S. C. Mandal and H. N. Mukherjee, Boron requirements of some Bihar Soils, III, 362.

Ali, S. M., The role of Geography in City and Regional Planning, III, 213.

Ambegaokar, K. B. and V. G. Pathak, Embryological Studies in Acanthaceae : The Female Gametophyte, III, 227.

Amin, J. V. and C. C. Shah, Manganese status of Soils of Western India—II. Content of Manganese in Plant Leaves, III, 365.

Ambekar, V. R. and K. K. Dole, Studies on the Solubility of Dehydrated Castor Oil, III, 154.

Amin, J. V. and C. C. Shah, Manganese Status of Soils of Western India—I, III, 364.

Amin, P. A. and J. L. Bhatt, Training Within Industry—Baroda Project, III, 413.

Anand, B. K., Hypothalamic control over certain vegetative functions, III, 387.

Applied Ecology, IV, 81.

Apte, L. M. and G. B. Kolhatkar, Catalytic decomposition of potassium chlorate in the presence of a mixture of catalysts and determination of the temperature coefficient of the decomposition, III, 95.

Arnkar, H. J., An Oscillographic Study of the Time Disparity in the Production and Annulment of the Joshi Effect, III, 31.

Arnkar, H. J. and R. J. Galagali, The 'Corona Pressure' and the Thermionic Analogue of Joshi Effect in Hydrogen, III, 32.

Arnkar, H. J. and R. J. Galayali, Effect of Aviny under discharge of the Resistance of Platinum Electrode, III, 32.

Arora, R. B., B. N. Consul and V. N. Sharma, "Clinical Trial of 'P-267' in Ophthalmic Surgery", III, 337.

Arora, R. B. and V. N. Sharama, Pharmacological investigations of Di (B-O-Methoxyphenyl-isopropyl)—amine lactate (U-0069 code name) : A new local anaesthetic, III, 338.

Arora, R. B. and P. K. Das, Action of commonly used intravenous anaesthetics in Medical and Veterinary practice, on the Auriculo-Ventricular node, III, 337.

Arora, Nirmal, Origin and developmental morphology of the root nodules on *Cicer arietinum* L., III, 220.

Arora, G. L., Coupling apparatus and its bearing on the relationship of insects, III, 292.

- Arora, R. B. and P. K. Das, Experimental production and maintenance of Auriculo-Ventricular nodal rhythm in mammals, III, 391.
- Arora, R. B. and P. C. Dandiya, The Antiveratrinic action of various Cinchona alkaloids and Cupreines, III, 397.
- Asthana, H. S., Some Configurational Analysis of Rorschach Scores, III, 407.
- Arora, R. B. and P. C. Dandiya, A study of the Antiveratrinic Activity of Anti-malarial Drugs, III, 397.
- Argikar, G. P., Observations in the genetic improvement of a green seeded strain of *Cicer arietinum* L., III, 371.
- Asthana, H. S., A study of the 'Erfassungstypus' in the Rorschach Test, III, 407.
- Atchutaramamurti B. and J. Venkateswarlu, Contribution to the Embryology of two Boraginaceae, III, 237.
- Athavale, J. B., M. G. Marathe and K. G. Gore, Synthesis of Dihydro Flavonol and Flavonols, Part V : Synthesis of 5 : 6-substituted flavonols, III, 119.
- Athawale, V. D., Om Prakash, Atma Ram and S. C. Pandey, Isomerisation of Linseed Oil, III, 162.

B

- Baidya, S. P., Boundary Correction of Mohr's Theory on Cohesive Soil and its Application to the Problem of Retaining Wall -III, III, 415.
- Baksi, Subhendukumar, Petromineralogy of the Rajmahal Traps, Santhal Parganas, Bihar, III, 193.
- Balakrishnamurthy, G. and Kandula Pampapathi Rao, Preliminary observations on the zonation of the fauna and flora of the intertidal rocks at Waltair, III, 315.
- Bal, Chandra and Miss P. V. Ranjini, On the occurrence of *Opalina* scalpriformis in the rectum of *Rana tigrina*, III, 281.
- Bal, Chandra and Bhuwan Prakash Rai, On the occurrence of *Stenophora* sp. in the midgut of *Blatta orientalis*, III, 281.
- Bal, D. V., Miss D. S. Ghanekar and Mrs. K. Sohoni, The Enzymes of Some Elasmobranchs from Bombay : Amylases, III, 302.
- Rai, A. R. Kasturi, Analysis of Chromosomes in two genera of Microhylidae (Amphibia : Anura), III, 269.
- Bal, D. V. and V. C. Palekar, A Preliminary Note on the Marine Organisms injurious to Submerged Timber in the Bombay Harbour, III, 313.
- Ballal, D. K., T. L. Deshpande and R. J. Kalamkar, Effect of growing cotton in rotation with the different crops on structure of flack cotton soil, III, 363.
- Bal, D. V. and G. G. Datar, The inter-relationships between total-length, standard length, poly-weight and gonad-weight of *Megalaspis cordyla*, III, 301.
- Ba, D. V., (Miss) P. D. Nayak and (Miss) M. R. Varde, The Air-pladder and its Relation with the Auditory Organ of *Hilsa tili*, III, 302.
- Bandyopadhyay, Debabrata, Thioumeline as an Analytical Reagent, III, 78.
- Bandyopadhyaya, G., Separable Solution of place Compressible flow in heat conducting gas, III 11.
- Bandyopadhyay, G. and R. K. Narasimhan, A Special Technique of Relaxation Methods in Simultaneous Equation, III, 415.
- Banerjee, D. and R. G. Chatterjee, Comparative Study of Interests in Professions and College-Subjects, III, 410.
- Banerjee, S. C. and D. K. Banerjee, The Angle of Arrival of Scattered Radio Signals from the Ionosphere and the Location of the Scattering Centres on the Ground, III, 424.
- Banerjee, S. S. and J. P. Srivastava, Predicted and observed critical frequencies for F_2 region of the ionosphere, III, 422.
- Banerjee, S. S. and P. C. Banerjee, Vertical Polar Diagrams of an Ultra-short Wave Horizontal Dipole Aerial, III, 421.
- Banerjee, S. S. and D. K. Banerjee, The Distance of Scattering Centres on the Ground for Maximum Intensity of Scattered Radio Signals, III, 423.
- Banerjee, Sachchidananda, Nicotinic Acid Metabolism in the Rhesus Monkey, III, 384.
- Banerjee, Sachchidananda, Nicotinic Acid Metabolism in the Rhesus Monkey, III, 384.
- Banerjee, Sachchidananda, Glucose Tolerance in Health and in Typhoid Fever, III, 338.
- Banerjee, R., K. K. Chatterjee, H. N. Chatterjee, R. K. Saha, D. K. Ghosh and H. Ghosh, A Study of Pyrexia and some febrile and other Inflammatory Complications of Cholera, III, 332.
- Banerjee, J. C. and A. Sen, Clinical Evaluation of Certain Antibiotics in the Treatment of Diphtheria, III, 334.

- Banerjee, R., Hemendranath Chatterjee, K. K. Chatterji and P. R. Chakravarty, A Further Study of Alimentary Symptoms of Cholera, III, 330.
- Banerjee, A. K. and P. Nandi, Biological studies on a strain of *Streptomyces* producing an antifungal antibiotic, III, 211.
- Banerjee, Barundeb and D. Mukherji, Anatomy of the termite, *Odontotermes rede-manni* (Wasmann), III, 289.
- Banerjee, B. S., H. N. Mukherjee and S. C. Mandal, Increasing the fertiliser phosphate availability to plants and testing chemical methods for available phosphate determination, III, 259.
- Banerji, A. K., On some Shear-zone Epidiorites from South of Tatanagar, Bihar, III, 192.
- Banerjee, Ramprasad and Sudhish Nandy, Observations of the action of papain on casein, III, 147.
- Banerjee, Ramaprasad and Sudhish Nandy, Casein viscosity in proteinase evaluation, III, 105.
- Banerjee, H. K., Chemical Assay of Antibiotics: (a) A Colorimetric determination of Streptomycin Dihydrostreptomycin, their mixtures and derivatives in Medical Preparations, III, 82.
- Banerjee, Satyendra Nath and Sushil Kumar Siddhanta, The Dissociation of Cobalt Acetate in Aqueous Solution, III, 104.
- Banerjee, Siddheshwar and Anil Kumar Majumdar, Estimation of Silica, III, 78.
- Banerjee, D. P., On the distribution of the ratio of classical D^2 -statistics based on p and q characters.
- Banerjee, S. S. and T. V. S. Murty, Resistance of Electrical Wires at Ultra-high Frequencies and its Effect on the Measurement of Wavelength by Lecher Wires, III, 423.
- Banerjee, D. K. and S. S. Banerjee, The Angle of Arrival of Scattered Radio Signals from the Ionosphere and the Location of the scattering Centres on the Ground, III, 424.
- Banerjee, D. K. and S. S. Banerjee, The Distance of Scattering Centres on the Ground for Maximum Intensity of Scattered Radio Signals, III, 423.
- Banerjee, P. C. and S. S. Banerjee, Vertical Polar Diagrams of an Ultra-short Wave Horizontal Dipole Aerial, III, 421.
- Barayanan, E. S. and S. Z. Haider, Some Biological Factors influencing the Segregation in *Bracon* (*Microbracon*) *gelechiæ* Ashmead (Hymenoptera: Braconidae), A Larval parasite of the Potato Tuber Moth, *Gnorimoschema* (*Phthorimaca*) *operculella* (Lepidoptera: Gelechiidae), III, 382.
- Barayanan, E. S. and S. Z. Haider, Some Biological Factors in *Bracon* (*Microbracon*) *gelechiæ* Ashmead (Hymenoptera: Braconidae), A Larval parasite of the Potato Tuber Moth, *Gnorimoschema* (*Phthorimaca*) *operculella* (Lepidoptera: Gelechiidae), III, 382.
- Bari, M. F., R. S. Roy and R. K. Singh, Effect of Spacing on the Growth and Fruiting of Tomato Var Marglobe Labour, III, 357.
- Barua, A. K., (Mrs.) D. Chakravarti and R. N. Chakravarti, Saponins from Indian *Dioscorea* Plants, III, 141.
- Barua, A. K. and J. K. Roy, Preparation of suitable intermediate for the synthesis of resin acids: Synthesis of 6-methyl-6-carbomethoxy-acetyl-cyclohexene, III, 129.
- Barua, A. K., J. K. Roy and S. K. Das Gupta, Synthesis of 5, 6, 11, 12-Tetrahydrochrysene, III, 130.
- Barua, A. K., D. Chakravarti and J. K. Roy, On the Constitution of Entagenic Acid, a new triterpenoid isolated from the seeds of *Entada pursaetha*, DC, III, 129.
- Basak, B. S., A Complete Crystal Structure Analysis of Phenanthrene by the Fourier Synthesis Method, III, 93.
- Basak, C. C. and N. C. Nivogi, Studies on Fischer-Tropsch Synthesis: Part V. Effects of Different Iron Catalysts at Atmospheric Pressure, III, 174.
- Basu, S. K. and Subodh Mitra, The assessment of the type and size of Indian Female Pelvis, III, 327.
- Basu, Deb Kumar, Hemendra Nath Chatterjee and Priya Ranjan Chakravarty, A Study of Cholera Stools and the Associated Clinical Features, III, 331.
- Basu, Amitava, S. K. Basu and P. R. Deb, A Study of Epiphysial Union in Long Bones of Bengalee Adolescents, III, 327.
- Basu, S. K., B. N. Mukherjee, S. K. Ray and Amitava Basu, A Study of the weights of some viscera from 2000 necropsies in Calcutta, III, 327.
- Basu, M. N., An anthropological investigation among the Refugees of Bengal, III, 325.
- Basu, S. K., P. R. Deb and Amitava Basu, A Study of Epiphysial Union in Long Bones of Bengalee Adolescents, III, 327.

- Basu, Amitava, S. K. Basu, B. N. Mukherjee and S. K. Ray, A study of the weights of some viscera from 2000 necropsies in Calcutta, III, 327.
- Basu, J. N., Power in India during the Last Half a Century, III, 424.
- Basu, U. P. and A. Raychaudhuri, Synthesis of 8-aminoquinolines : Part VI, III, 134.
- Basu, U. P. and M. L. Sen Gupta, On the Effect of Bleaching of Arachis Oil, Basu, M. R. and H. N. Das Gupta, Studies on South Arcot Lignite, III, 431.
- Basu, D., On statistics independent of a complete sufficient statistic, III, 17.
- Bhaduri, P. N. and B. R. Majumdar, Pollen grain Smear Method for Cereals, III, 253.
- Bhaghat, K. P., Some Important Psychological Apparatus, III, 405.
- Bhagwatwar, D. A., Petrography of the basic doleritic intrusives in the Chittorograph area, III, 200.
- Bharodwaj, S. N., Effect of sowing date on Shrivelling of Wheat grains in Cultivator's fields, III, 356.
- Bhatavdekar, M. Y. and S. Rammohan Rao, Further Observations on the Species of Coccidia Affecting Dogs and Cats with Particular Reference to a New Coccidium Belonging to the Genus Eimeria, III, 350.
- Bhatt, L. I. and P. A. Amin, Training Within Industry—Baroda Project, III, 413.
- Bhat, N. R. and N. D. Desai, Genetic Investigations of the 'Whorled' Mutant in *Gossypium herbaceum*, III, 245.
- Bhat, L. S. and R. V. Joshi, Petrology and Morphology of the Deccan Trap flows around Kolhapur (Bombay State), III, 196.
- Bhatt, M. R. and N. N. Shah, Coumarins derived from p-alkyl-phenols, III, 126.
- Bhatt, M. R. and N. M. Shah, Studies in Fries Migration. The Fries Isomerisation of acyl esters of ortho and para-hydroxy-acetophenones and para-hydroxy-benzophenone, III, 128.
- Bhatt, S. N. and B. N. Prasad, On the Summability Factors of a Fourier Series, III, 1.
- Bhattacharya, Gangagobinda, A comparative study of Oxygen Consumption by tissue slices of normal Alloxanized Rats III, 395.
- Bhattacharya, S., B. N. Chowdhuri, N. K. Iyenger and M. D. Chakravarti, Quality of Liver injections, III, 402.
- Bhattacharya, P., D. P. Mukherjee and B. C. Joshi, Effect of Ovariectomy, Subcutaneous Grafting of Ovaries and Administration of Ovarian Hormone (Oestroform) on the Rate of Respiration, Body Temperature and Blood Morphology of Rabbits, III, 400.
- Bhattacharya, P. and P. N. Srivastava, Studies on deep freezing of buffalo semen, III, 348.
- Bhattacharyya, Asutosh, The Birjias of Palamau, III, 324.
- Bhattacharya, Asutosh, Some Ailments and their Remedies among the Hill Soras (Savaras) of Orissa, III, 322.
- Bhattacharyya, Miss Bibha and A. K. Sharma, Vitamins—their Property of Inducing Chromosome Division in Permanent Cells, III, 251.
- Bhattacharya, A. P., Study of the effects of deforestation on the intensity and frequency of rainfall and floods in Patliri, Ranipur and Ratmau Torrents, III, 208.
- Bhattacharya, A. P., Penetration of rain water to ground water table in Doabs west of the Ganga River, III, 209.
- Bhattacharyya, Bidyut Kamal and Jadugopal Dutta, Sitosterols from *Mimosa pudica* Linn., III, 141.
- Bhattacharyya, S. K. and K. S. De, Thermal decomposition of Diazo-salt under pressure, III, 101.
- Bhattacharya, G. C. and P. C. Sinha, Pressure—Composition Isothermals of the Systems : Zinc Sulpha-a-Picoline-Water and Cadmium Sulphate-a-Picoline-Water at 60°C, III, 105.
- Bhattacharyya, S. K. and D. K. Nandi, Thermal Decomposition of Formaldehyde at High Pressure, III, 102.
- Bhattacharyya, A. K. and N. R. Subbaratnam, The Problem of Enhanced Light Absorption in the Ultraviolet in Iodine Reactions, III, 91.
- Bhattacharyya, S. K. and V. S. Ramchandran, Thermal Decomposition of Chromic Trioxide, III, 83.
- Bhattacharyya, A. P., Cycle of rainfall in some districts of U. P., III, 20.
- Bhattacharyya, Sukhamoy, Determination of Copper in Colloidal Preparation, III, 81.
- Bhattacharyya, S. K. and I. B. Gulati, Catalytic Vapour Phase Oxidation of Ortho Xylene, Part II, III, 166.
- Bhattacharyya, S. K. and I. B. Gulati, Differential Thermal analysis of promoted Silver Oxide Catalysts, III, 100.
- Bhattacharyya, S. K., Synthesis of Saturated Carboxylic Acids at high Pressures, III, 163.

- Bhattacharyya, P. K., Study of the effect of unequal error variances on the pooled F test, III, 15.
- Bhattacharyya, P., K. Pal, S. N. Luktuke and S. K. De, Studies on ascorbic acid content in the semen of hill bulls and buffalo bulls and its correlation with the seminal fructose and semen equality, III, 400.
- Bhattacharyya, S. K., Miss S. Kameswari and V. S. Ramachandran, Differential Thermal analysis of Catalyst powders : System : $\text{ThO}_2\text{Al}_2\text{O}_3$, III, 100.
- Bhattacharya, S. R., P. N. Sharma and S. N. Dutta, Study of Electrolytic Dissociation by X-Ray diffraction-II, III, 35.
- Bhattacharya, A. P., Study of double cropped area in some districts of U.P., III, 361.
- Bhattacharya, A. P., Correlation analysis between temperatures of water from Upper Ganpa Canal near Bahadrad and water from Pathri Power House Pits, III, 416.
- Bhatt, N. M., A method of determining a quantile from grouped data, III, 13.
- Bhattacharya, A. P., Study of the effects of pumping by the tube wells in Doabs west of Ganga River, III, 418.
- Bhatia, M. L., *Haemadipsa zeylanica agilis* (Moore), A Land Leech from Nainital and Almora, III, 286.
- Bhatnagar, S. P. and D. P. Sadhu, Measurement of Surface Area in Goats, III, 347.
- Bhatnagar, M. P. and C. S. Pande, Formation of Complex Compounds between Urea and Alkaline Earth Halides—Pt. VI. The System : $\text{BaBr}_2\text{-CO(NH}_2)_2\text{-H}_2\text{O}$ (Surface Tension and Refractive Index), III, 86.
- Bhatnagar, M. P. and C. S. Pande, Formation of Complex Compounds between Urea and Alkaline Earth Halides—Pt. V. The System : $\text{BaBr}_2\text{-CO(NH}_2)_2\text{-H}_2\text{O}$ (Conductivity and Viscosity).
- Bhatnagar, M. P. and C. S. Pande, Formation of Complex Compounds between Urea and Alkaline Earth Halides—Pt. IX. The System : $\text{BaI}_2\text{-CO(NH}_2)_2\text{-H}_2\text{O}$ (Refractive Index and Freezing Point), III, 87.
- Bhatnagar, M. P. and C. S. Pande, Formation of Complex Compounds between Urea and Alkaline Earth Halides—Pt. VII. The System : $\text{BaBr}_2\text{-CO(NH}_2)_2\text{-H}_2\text{O}$ Rheochor, Parachor and Molecular Refraction), III, 87.
- Bhatnagar, M. P. and C. S. Pande, Formation of Complex Compounds between Urea and Alkaline Earth Halides—Pt. VIII. The System : $\text{BaI}_2\text{-CO(NH}_2)_2\text{-H}_2\text{O}$ (Conductivity and Viscosity), III, 87.
- Bhatnagar, S. P. and D. P. Sadhu, Comparative studies on Ionic Exchange in stretched and unstretched muscle, III, 389.
- Bhardwaj, S. N., Effect of long and short photoperiods on Incidence of flowering in wheat and gram, III, 256.
- Bhargava, P. N. and B. Chatteyya, Studies on 3-p-tolyl 2-p-tolylimino-4-thiazolidone, III, 122.
- Bhargava, P. N. and G. C. Goswami, Studies on 3-m-tolyl-2-m-tolylimino-4-thiazolidone, III, 122.
- Bhargava, P. N. and C. L. Kaul, Studies on 3-O Tolyl-2-O-Tolylimino-4-Thiazolidone, III, 122.
- Bhargava, P. N. and M. Srinivasa Sastry, Studies on 3-p-tolyl-2:4-thiazolidone, III, 123.
- Bhargava, P. N. and C. N. Vasudevan Nambury, Preparation of S-di-o-tolyl thio-barbituric Acid, III, 123.
- Bhargava, P. N. and A. Jogi Pantulu, Studies on 3-m-tolyl-2:4-thiazolidone, III, 123.
- Bhaskaran, T. R. and M. A. Sampathkumaran, Effect of Sewage and excreta disposal methods on Intestinal Parasites, III, 339.
- Bhide, B. V., V. M. Parikh and T. R. Ingle, Chemical investigation of "Bael mucilage" (*Aegle marmelos*; N. O. Rutaceae) Part I :—Composition of Bael mucilage, III, 140.
- Bhide, B. V., R. K. Hulyalkar and T. R. Ingle, Chemical investigation of "khair gum" (*Acacia catechu*; N. O. Leguminosae) Part I :—Composition of the khair gum, III, 139.
- Bhide, B. V., R. K. Hulyalkar and T. R. Ingle, Chemical investigation of the gum khair. (*Acacia catechu*; N. O. Leguminosae) Part II :—Structure of the aldo-bionic acid, III, 139.
- Bhide, B. V., V. M. Parikh and T. R. Ingle, Chemical investigation of Modal Gum. (*Lannea grandis*; N. O. Anacardiaceae), Part I :—Composition of Modal gum, III, 140.
- Bhide, B. V., R. K. Hulyalkar and T. R. Ingle, Chemical Investigation of "khair gum", (*Acacia catechu*, N. O. Leguminosae) Part I :—Composition of the khair gum, III, 139.
- Bhide, B. V., V. M. Parikh and T. R. Ingle, Chemical investigation of Modal Gum. (*Lannea grandis*; N. O. Anacardiaceae) Part II :—Structure of the aldo-bionic acid, III, 140.

- Bhide, B. V., R. K. Hulyalkar and T. R. Ingle, Chemical investigation of the gum khair. (*Acacia catechu*; N. O. Leguminosae) Part II :—Structure of the aldo-bionic acid, III, 139.
- Bhide, B. V., V. M. Parikh and T. R. Ingle, Chemical investigation of Modal Gum. (*Lannea grandis*; N. O. Anacardiaceae) Part I :—Composition of Modal gum, III, 140.
- Bhide, B. V., V. M. Parikh and T. R. Ingle, Chemical investigation of Modal Gum. (*Lannea grandis*; N. O. Anacardiaceae) Part II :—Structure of the aldo-bionic acid, III, 140.
- Bhrany, U. N. and M. R. A. Rao, Studies on Oxo reaction with alicyclic compounds, III, 112.
- Bluchar, V. M. and Verma, Volumetric method for iodimetric Determination of Vanadium, III, 80.
- Bhownick, Prabodh Kumar, A Short Note on the Savaras of Tanluk (Midnapur), III, 322.
- Bhownick, Prabodh Kumar, Lodha Village Organisation, III, 325.
- Behura, Basanta Kumar, Replacement of English by the Regional Languages as Medium of Instruction of Science in the Colleges, III, 410.
- Behura, Basanta Kumar, The Feeding Mechanism of *Histostoma Polyperi* (Oud.) 'Acani', III, 288.
- Behura, Basanta Kumar, Adaptive Coloration and Camouflage of the common Membracid, *Otinotus oneratus* wlaw, (Homoptera), III, 291.
- Bendale, D. S. and S. K. K. Jatkar, Utilisation of Agricultural Waste, III, 169.
- Betrabet, S. M. and B. S. Navalkar, Physical and Chemical Properties of Bast Fibres in relation to their Intrinsic Strength, III, 226.
- Penaari, N. P. and B. B. L. Mathur, Comparison of the amylolytic activity of the Saliva of new born infants and adult human subjects, III, 387.
- Biswas, H. G., A new Method for the Oxidation of 2:2'-dibenzoyloxy-4:4'-dinitro-diphenyl sulphide to the corresponding Sulphone, III, 121.
- Biswas, M. M., A New Method of Purification of Invertase from Brewer's Yeast, III, 142.
- Biswas, B., G. N. Gupta and V. N. Nigam, Preparation of activated carbon from Kans (*Caccharum Spontaneum*), III, 169.
- Biswas, Amal Kumar, J. N. Mukherjee and P. B. Sen, A new Anti-histaminic Substance, III, 394.
- Biswas, Amal Kumar, P. P. Sen and J. N. Mukherjee, Effect of Rauwolfscine on the Cholesterol and Ascorbic Acid Content of Adrenal Gland, III, 396.
- Bose, N. K., Silting of Reservoirs, III, 418.
- Bose, S., H. P. Tandon and S. G. Iyer, Studies on Up-grading of Indian Poultry, III, 315.
- Bose, A. N., Toxicity of Injectio Mersalyl, B.P., and Diethylamine-Asetarsol, III, 538.
- Bose, S., S. G. Iyer and H. P. Tandon, Economics of Different Breeds with Reference to Eggs Production, III, 344.
- Bose, S., S. G. Iyer and H. Tandon, Experiments with Puilt up Litter for Raising Chickens, III, 343.
- Bose, S., S. G. Iyer and A. K. Pal, Studies on the Effect of the Addition of Yeast Sludge in Normal and Simplified Laying Rations, III, 344.
- Bose, S., H. P. Tandon and S. G. Iyer, Studies on the Utilisation of Vitamin B₁₂ and Antibiotics in Poultry Feed, III, 344.
- Bose, A. N. and N. K. Roy, Milk in Treatment of Malaria, III, 332.
- Bose, Asoke and Sivatosh Mookerjee, Ionising Interference on the Levels of Organiser Action, III, 273.
- Bose, B. and A. K. Ghosh, Spores from Cabrian and pre-Cambrian beds of India and U.S.A., III, 267.
- Pose, Ajay K., The Shape of the Tropine Molecule, III, 137.
- Bose, S. and A. Chatterjee, Constitution of Ajmaline, the Alkaloid of *Rauwolfia Serpentina* Benth, III, 137.
- Bose, Ajay K., The Shape of the Tropine Molecule, III, 137.
- Bose, A. K. and B. G. Chatterjee, The Structure of Grifolin, III, 121.
- III, 89.
- Bose, Saroj Kumar, The Study of Na^+/K^+ reversibility on clay membrane electrodes, III, 176.
- Bose, Mihir, S. Ray Chaudhuri and Others, A note on the Geology around Simultala, Bihar, III, 176.
- Pose, Mihir and S. Ray Chaudhuri, On the pelites of the area around Simultala, Bihar, III, 185.
- Bose, A. N., Canning of Fish (Rohu, Labeo-Rohita), III, 160.
- Bose, Kalyan Kumar, On the Hysteresis of Tube Oscillator, III, 426.

- Bose Monisha, Isolation of the Chromate-Diphenylcarbazide Reaction Product and attempt, III, 119.
 Brijmohan and Shanti Sarup, Habits of Weeds of Jawant College Compounds, Jodhpur, III, 241.
 Burma, D. P., Two-dimensional paper Chromatography of some of the Organic Acids including those belonging to Krebs cycle, III, 78.

C

- Chacko, P. I., Hydrobiology and Fisheries of the Coteliar Estuary, Near Madras in 1953-54, III, 308.
 Chacko, P. I., Prospects for a pearl fishery off Tuticorin, Gulf of Manaar, in 1955, II, 309.
 Chacko, P. I., A review of the 1953-54 fishery of the Mackerel, *Rastrelliger kana-gurta*, of the west coast of Madras State, III, 308.
 Chacko, P. I., The 1953-54 bumper fishery of the oil-Sardine (*Sardinella longiceps*) of the west coast of Madras State, III, 307.
 Chacko, P. I., Hydrography and plankton of the inshort sea opposite the marine biological station, West Hill, Malabar Coast, in 1953-54.
 Chacko, P. I. and R. Srinivasan, Further experiments on the control of aquatic vegetation with 2,4-D, III, 317.
 Chacko, Conservation of the marine fauna and flora of Krusadai Inland, Gulf of Manaar, III, 316.
 Chacko, P. I., Spawning habits of the milk-fish, *Chanos chanos* (Forsk.) in the coastal waters of Madras State, India, III, 307.
 Chaki, M. C., On a Type of Metric Space, III, 7.
 Chanda, K. C. On some characterization properties of normal distributions, III, 13.
 Chandra, Ganesh, G. N. Gupta and D. R. Dhingra, The Indian Otto of Rose, III, 164.
 Chandra, Ganesh, G. N. Gupta and S. T. H. Zaidi, Dill seeds and herb oils, III, 167.
 Chandra, Prasad and Priyasankar Chakravarty, Tremolite-Actinolite rock from near Barundhia, Monghyr District, Bihar, III, 189.
 Chandy, N., Origin, Distribution, Phylogeny and Interrelationship of Ophicephalid Fishes (Snakeheads, Murrels of India), III, 304.
 Chari, K. S. and K. Ramalingam, Solvent Extraction of Vegetable Oils—Part I. Solubility of Safflower Oil in ethyl alcohol, III, 152.
 Chari, S. T. and R. Venkataraman, Amino Acid composition of Marine Fish Proteins, III, 305.
 Chavan, A. R. and J. J. Shah, Origin and development of the vegetative axillary bud in *Vitis repens* W. & A., III, 225.
 Chakrabarty, A., S. R. Chakrabarty, M. M. Chakrabarty and N. K. Sen, Studies on Jute Seed Oils, III, 157.
 Chakrabarty, M. M. and S. R. Chakrabarty, The Composition of Indian Tobacco Seed Oils—II, III, 158.
 Chakrabarty, S. R. and M. M. Chakrabarty, The Composition of Indian Tobacco Seed Oils—II, III, 158.
 Chakrabarty, Amiya Kumar, J. Xavier and Priyadarajan Ray, A Critical Review of the Methods for the Colorimetric Estimation of Chromium, III, 75.
 Chakrabarty, M. M., Dipti Kalyan Chowdhury and P. K. Mukherji, Studies on some Seed Fats of Cucurbitaceae Family—Part VII. Component Fatty Acids of the Seed Fat from *Momordica Charantia* Linn. Variety—'Proper' (Beng.—Karala), III, 156.
 Chakrabarty, M. M., Dipti Kalyan Chowdhury and B. K. Mukherji, Studies on Some Seed Fats of Cucurbitaceae Family—Part X. Component Fatty Acids from the Seed Fat of *Auffa Aegyptiaca* (Beng.—Dhundhul), III, 158.
 Chakrabarty, M. M., Dipti Kalyan Chowdhury and B. K. Mukherji, Studies of some seed fats of Cucurbitaceae family—Part III The component fatty acids of *Tricosanthus Anguina*, III, 157.
 Chakrabarty, M. M., A. Chakrabarty, S. R. Chakrabarty and N. K. Sen, Studies on Jute Seed Oils, III, 157.
 Chakrabarty, M. M., Dipti Kalyan Chowdhury and B. K. Mukherji, Studies on some Seed Fats of Cucurbitaceae Family—Part IX. Component Fatty Acids of the Seed Fat *Luffa Acutangula*, (Beng.—Jhinga), III, 157.
 Chakrabarty, S. R. Chakrabarty, M. M. Chakrabarty and N. K. Sen, Studies on Jute Seed Oils, III, 157.
 Chakrabarty, S. N., Colorimetric Estimation of Exchangeable Iron in Soils, III, 94.
 Chakrabarty, G. and Bhabani Charan Ghosh, Primary Hepatic Carcinoma, III, 328.

- Chakraborty, Aniya Kumar, J. Xavier and Priyadarajan Ray, A Critical Review of the Methods for the Colorimetric Estimation of Titanium, III, 77.
- Chakraborty, Aniya Kumar, J. Xavier and Priyadarajan Ray, A Critical Review of the Methods for the Colorimetric Estimation of Palladium, III, 76.
- Chakravarti, R. N., A. K. Barua and Mrs. D. Chakravarti, Saponins from Indian Dioscorea Plants, III, 141.
- Chakravarti, I. M., Comparison of expected lengths of confidence intervals for mean for two methods of sampling from normal population, III, 17. •
- Chakrabarty, M. M., Anupam Sen Gupta and S. R. Chakrabarty, The seed fat composition of Albizzi Lebbeck, III, 152.
- Chakrabarty, M. M., Dipti Kalyan Chowdhury and P. K. Mukherji, Studies on Some Seed Fats of Cucurbitaceae Family—Part VI. Component Fatty Acids of the Seed Fat from Momordica Charantia Linn. Variety—Muricata (Bengali—Ucche), III, 156.
- Chakravarti, M. D., B. N. Chowdhury, N. K. Iyenger and S. Bhattacharya, Quality of Liver injections, III, 402.
- Chakrabarty, M. N., D. K. Chowdhury and B. K. Mukherji, Studies on some seed fats of Cucurbitaceae family—Part V, III, 155.
- Chakravarty, Tarakeshwar and Asima Chatterjee, Swietenolide, the bitter Principle of Swietenia Macrophylla, III, 135.
- Chakravarti, D., J. K. Roy and A. K. Barua, On the Constitution of Entagenic Acid, a new triterpenoid isolated from the seeds of Entada pursaetha DC., III, 129.
- Chakravarti, (Mrs.) D., A. K. Barua and R. N. Chakravarti, Saponins from Indian Dioscorea Plants, III, 141.
- Chakrabarti, C. H. and M. C. Nath, Biosynthesis of ascorbic acid and prevention of glycogen depletion in Liver and Muscle, III, 146.
- Chakrabarti, C. H., M. C. Nath and S. G. Naidu, Effect of Methionine and Casein on Acetoacetate induced Hyperglycemia, III, 385.
- Chakravarti, S. C. and V. N. Krishna Pillai, The effects of certain synthetic growth regulators on the vernalization of Brassica campestris L., III, 253.
- Chakravarty, S. C. and M. K. Mukherjee, Exhibition of the Soil and Uptake of Nutrients by Different Varieties of Jute Grown under the same conditions, III, 376.
- Chakravorty, S. C., M. K. Mukherjee, A. K. Kundu and G. Halder, Jute leaves as manures : I : Influence on the growth of paddy, III, 360.
- Chakrabarti, N. K. and S. P. Chattopadhyay, Variability in resistance or susceptibility of different varieties of paddy to infection of Helminthosporium Oryzae Breda de Haan, III, 217.
- Chakrabarty, S. R., A. Chakrabarty, M. M. Chakrabarty and N. K. Sen, Studies on Jute Seed Oils, III, 157.
- Chakrabarty, S. R., Anupam Sen Gupta and M. M. Chakrabarty, The seed fat composition of Albizzi Lebbeck, III, 152.
- Chakravarti, S. K. and M. N. Goswami, Thiocyanometric Titrations Catalysed with Mercuric Salts, III, 78.
- Chandrasekharaiva, T. and E. R. Sundarajan, The Spurt in the Expectation of Life in Mysore State, IV, 2.
- Chandratreya, P. V. and N. R. Tawde, A case for the fixation of internuclear separation (A) in E^2 , ΔE^2 levels of LaO from intensity characteristics, III, 28.
- Chandratreya, P. V. and N. R. Tawde, Anomalous temperature of T_{10} bands in carbon arc, III, 28.
- Chakravarty, Priva Ranjan, Hemendra Nath Chatterjee and Deb Kumar Basu, A Study of Cholera Stools and the Associated Clinical Features, III, 331.
- Chakravarty, Privasankar and Prasad Chandra, Tremolite-Actinolite rock from near Baraundha, Monghyr District, Bihar, III, 189.
- Chakravarty, P. R., Hemendranath Chatterjee, K. K. Chatterji and R. Banerjee, A Further Study of Alimentary Symptoms of Cholera, III, 330.
- Chatterjee, B., The Engineering Projects of a Loam Soil of West Bengal effect of Base Saturation with Aluminium, III, 416.
- Chatterjee, Migration and growth of Explanted Tissues from Cancer Cervix by Autologous and Homologous Serum and Plasma Incorporated in the Medium, III, 402.
- Chatterjee, Anupam, Neural Plock—its Application to Ophthalmology, III, 349.
- Chatterjee, Anupam, The Chemotherapeutic Properties of Sulphadimidine—a Clinical Study, III, 349.
- Chatterjee, Hemendra Nath, Therapeutic Control of the Chief Alimentary Symptoms of Cholera. A Preliminary Study, III, 330.

- Chatterjee, Anupam, Retention of Placenta in the Bovines—A Clinical study on the efficiency of Stibioestrol in expulsion of the placenta, III, 348.
- Chatterji, K. K., Hemendranath Chatterjee, P. R. Chakravarty and R. Banerjee, A Further Study of Alimentary Symptoms of Cholera, III, 330.
- Chatterjee, H. N., K. K. Chatterjee, R. K. Saha, R. Banerjee, D. K. Ghosh and H. Ghosh, A Study of Pyrexia and some febrile and other Inflammatory Complications of Cholera, III, 332.
- Chatterjee, Hemendra Nath, Deb Kumar Basu and Priya Ranjan Chakravarty, A Study of Cholera Stools and the Associated Clinical Features, III, 331.
- Chatterjee, Hemendranath, K. K. Chatterji, P. R. Chakravarty and R. Banerjee, A Further Study of Alimentary Symptoms of Cholera, III, 330.
- Chatterjee, K. K., H. N. Chatterjee, R. K. Saha, R. Banerjee, D. K. Ghosh and H. Ghosh, A study of Pyrexia and some febrile and other Inflammatory Complications of Cholera, III, 332.
- Chatterjee, Anupam, Prevalence of Infectious Coryza amongst Pigeons, III, 346.
- Chatterji, P. N., On a new species of the genus *Lutztrema* Travassos, 1941, III, 282.
- Chatterjee, T. P., H. K. Mookherjee and D. N. Ganguly, On the development of the notochord and the vertebral column in the Cyprinodont, *Orisias melastigma* (McClelland), III, 278.
- Chatterjee, A. B. and Mrs. Mira Guha, Serampore : An Urban Study of a Stellite Town, Calcutta, III, 215.
- Chatterjee, Sunil Kumar, A note on the occurrence of Galena near Beldih, Manbhum district, Bihar, III, 205.
- Chatterjee, B., On Desulphurisation of Alloys in Hydrogen, III, 174.
- Char, T. L. Rama, S. Satyanarayana and K. R. Krishnaswami, Electrodeposition of Nickel and Zinc from the Sulphamate Bath, III, 173.
- Chatterjee, A. and S. Pakrashi, Studies on the Steric hindrance to N-acylation of Indole-NH group in Rauwolfscine, the Alkaloid of *Rauwolfia canescens*, *Linn.*, III, 136.
- Chatterjee, Asima and Tarakeshwar Chakravarty, Swietenolide, the bitter Principle of *Swietenia Macrophylla*, III, 135.
- Chatterjee, A. and S. Bose, Constitution of Ajmaline, the Alkaloid *Rauwolfia Serpentina* Benth, III, 137.
- Chatterjee, B. G. and A. K. Bose, The Structure of Grifolin, III, 121.
- Chatterjee, B. and P. N. Bhargava, Studies on 3-p-tolyl 2-p-tolylimino-4-thiazolidone, III, 128.
- Chatterjee, P., Effects of sunrise in different Ionospheric regions, III, 23.
- Chatterjee(A., The Variation of Cationic Activity in Colloidal with Concentration of the Disperse-phase, III, 93.
- Chatterjee, K. K., P. C. Sinha and S. N. Sanyal, Hydrolysis of Phosphorous Trichloride and Preparation of Phosphorous Tetratoxide, III, 85.
- Chatterji, A. C. and M. C. Rastogi, Distribution of the sparingly Soluble Salts in Banded Structures. Part III, 105.
- Chatterjee, S. C., Note on the Feldspars of the Chatnockitic rocks of the Mor Valley, Sonthal Parganas, Bihar, III, 182.
- Chatterjee, R. G. and D. Banerjee, Comparative Study of Interests in Professions and College-Subjects, III, 410.
- Chattopadhyay, S. B. and N. K. Chakrabarti, Variability in resistance or susceptibility of different varieties of paddy to infection of *Helminthosporium Oryzae* Breda de Haan, III, 217.
- Chattopadhyay, S. N. and Krishna Mukherji, The Potato wilt caused by *Pseudomonas Solanacearum* Var. *Asiatica* (E. F. Smith) Stapp. in West Bengal, III, 217.
- Chattopadhyay, S. B. and Krishna Mukherji, Pigment formation of *Serratia Marcescens* Bizio—reported from India for the first time, III, 218.
- Chatterjee, G. P. and J. K. Mukherjee, Changes in Thermoelectro-motive Forces on Low Temperature Tempering of Quenched Steel Samples, III, 428.
- Chatterjee, G. P. and S. S. Pani, Studies on the Ionic Nature of Molten Alloys with Particular Reference to Al-Si Alloys, III, 430.
- Chatterjee, G. P., Thermodynamics of Interfaces between Metallic Crystal Grains, III, 429.
- Chatterjee, G. P., Amplitude decay characteristics of damped vibrations in metallic materials, III, 430.
- Chatterjee, G. P., K. C. Som and A. K. Lahiri, Vibration Damping Characteristics of some Typical Metals and Alloys, III, 431.
- Chatterjee, G. P. and K. C. Som, X-ray diffraction studies of Carbon Steel samples super-saturated with hydrogen, III, 428.
- Chatterjee, P., On Dephosphorisation of White cast Iron in Hydrogen, III, 426.
- Chakravartti, Manish, Heights and Weights of West Bengal School Boys, III, 319.

- Chaudhuri, Bhupendra Nath, Ajit Maiti and B. B. Sarkar, Effect of Kuksine—the active principle of *Vernonia cinerea* (less) on the clotting activity of blood, II, 393.
- Chaudhuri, D. K., Isolation of the bound nicotinic acid from rice bran, III, 145.
- Chaudhuri, Monoranjan, Relocation and Re-development of the Indian Sugar Industry—A Study in locational Geography, III, 216.
- Chaudhuri, M. W., The Mineralogy of the Beryl Group, III, 185.
- Chaudhuri, K. R. and D. V. Gogate, A Simple Viscometer, III, 39.
- Chaudhuri, A. K., Biased steps along a line, III, 14.
- Chaudhuri, S. B., Statistical Quality Control and its use in Engineering Concerns, III, 415.
- Chaudhuri, A. K. and S. C. Shome, Inhibition of Corrosion of Steel by Pigments, III, 172.
- Chowdhury, S. B. and D. P. Sadhu, Bio-chemical studies in the blood of normal goats of Jamnapuri breed, III, 347.
- Choudhuri, J. K. and S. C. Das Gupta, Harmonic Elimination Equipment, III, 421.
- Chowdhuri, B. N., N. K. Iyengar, M. D. Chakravarti and S. Bhattacharya, Quality of Liver injections, III, 402.
- Choudhuri, Niren, Gautamsankar and Arati Sarkar, The Birth and Pregnancy Rites among the Oraons, III, 326.
- Chowdhuri, B. N., Oxytocic Activity of Vitamin C., III, 399.
- Chowdhuri, B. N. and D. P. Ghosh, Local Anaesthetic Effects of Mephenesin, III, 396.
- Chowdhury, A. K. and P. B. Sen, Effect of Infra-red irradiation of spermatogenesis of guineapigs, III, 402.
- Chowdhury, Dipti Kalyan, M. M. Chakrabarty and P. K. Mukherji, Studies on Some Seed Fats of Cucurbitaceae Family—Part VI. Component Fatty Acids of the Seed Fat from *Momordica Charantia* Linn. Variety—*Muricata* (Bengal—Ucche), III, 156.
- Chowdhury, Dipti Kalyan, M. M. Chakrabarty and B. K. Mukherji, Studies on some Seed Fats of Cucurbitaceae Family—Part VII. Component Fatty Acids of the Seed Fat from *Momordica Charantia* Linn. Variety—'Proper' (Beng.—Karala), III, 156.
- Chowdhury, D. K., M. M. Chakrabarty and B. K. Mukherji, Studies of some seed fats of Cucurbitaceae family—Part V, III, 155.
- Chowdhury, Dipti Kalyan, M. M. Chakrabarty and B. K. Mukherji, Studies on Some Seed Fats of Cucurbitaceae Family—Part X. Component Fatty Acids from the Seed Fat of *Auffa Aegyptiaca* (Bengal—Dhundhul), III, 158.
- Chowdhury, Dipti Kalyan, M. M. Chakrabarty and B. K. Mukherji, Studies on Some Seed Fats of Cucurbitaceae Family—Part IX. Component Fatty Acids of the Seed Fat *Luffa Acutangula* (Beng.—Jhinga), III, 157.
- Chowdhury, Dipti Kalyan, M. M. Chakrabarty and P. K. Mukherji, Studies of some seed fats of Cucurbitaceae family—Part VIII. The component fatty acids of *Tricosanthes Anguina*, III, 157.
- Chowdhury, Dipti Kalyan and B. K. Mukherji, Studies on Dehydration of Castor Oil. Part I, III, 149.
- Chiplonkar, G. W., P. N. Jagatap and B. R. Patel, A Preliminary Note on the Dykes of Hirapur-Narwa area in Sangor District, Madhya Pradesh, III, 203.
- Chiplonkar, G. W., K. C. Dubey and P. S. Agarkar, A Preliminary Note on the Petrography of the area around Jhansi, III, 186.
- Chiplonkar, M. W., P. V. Kulkarni and D. V. Badve, Further Studies of the Twilight Illumination, III, 26.
- Chibber, H. L., Radial Drainage of the Mikir Hills, Assam, III, 211.
- Chibber, H. L., Some Glacial Lakes of the Pir Panjal Range, III, 210.
- Chibber, R. K., M. A. Idnani and A. B. Ghosh, Effect of dipping paddy seedlings in nutrient solutions before transplanting, III, 375.
- Chibber, R. K., M. A. Idnani, A. B. Ghosh and M. B. Sengupta, Fertilizer value of Dicalcium phosphate in non-acid calcareous soils of India, III, 364.
- Chopra, R. N. and R. C. Sachar, Experiments on induced Parthenocarpy in some plants, III, 267.
- Chopra, R. N., P. Maheshwari and R. C. Sachar, Embryological Studies in Mango (*Mangifera Indica* L.), III, 233.
- Chothia, F. S., Predicting Success in Colleges, III, 411.
- Cohly, M. A. and M. R. A. Rao, A micro-electrophoretic study of the interaction between sodium dodecyl sulphate and crystalline bovine plasma albumin, III, 144.
- Consul, B. N., R. B. Arora and V. N. Sharma, "Clinical Trial of 'P-267' in Ophthalmic Surgery", III, 337.
- Crime and Society, IV, 134.

D

- Dadape, V. V. and M. R. A. Rao, Conductometric studies on the complexes of ferric chloride and phosphorus oxychloride, III, 99.
- Dandiya, P. C. and R. B. Arora, A study of the Antiveratrinic Activity of Antimalarial Drugs, III, 397.
- Dandiya, P. C. and R. B. Arora, The Antiveratrinic action of various Cinchona alkaloids and Cupreines, III, 397.
- Das, N. B. and Y. P. Gupta, Essential amino-acid contents of legumes and grasses (Methionine, Cystine and Tryptophane), III, 375.
- Das, P. K. and R. B. Arora, Experimental production and maintenance of Auriculo-Ventricular nodal rhythm in mammals, III, 391.
- Das, Jajneswar, Signal analysis and audio characteristics of Pulse-slope Modulation, III, 427.
- Das, Hyperventilation and E.E.G. changes, III, 388.
- Das, N. N. and R. N. Roy, Effect of Extract of Symplocos Cortex (Bengali Lodh) on the Toad's Heart, III, 398.
- Das, N. N., Electromyographic Studies on Yoga postures (Yogic Asanas), III, 389.
- Das, N. N., Studies on E.E.G. of the Deaf and Dumb Teenage School Boys and Girls, III, 388.
- Das, N. N., P. B. Sen, J. N. Mukherjee and M. N. Razdan, A Hypnotic Action of Rauwolfscine, III, 396.
- Das, N. N., J. N. Mukherjee and P. B. Sen, Effect of Rauwolfscine on the central nervous system, III, 395.
- Das, S. K., H. K. Mookerjee and D. N. Ganguly, On the structure and development of the Weberian apparatus in a Silurid fish, *Silindia gangetica*, III, 303.
- Das, S. M., The myology of *Funambulus palmarum* Waterhouse (the Indian palm squirrel), IV, 12.
- Das, S. M. and D. B. Saxena, On intermediate stages in evolution of afferent arches from fishes to amphibia, IV, 11.
- Das, S. M. and S. K. Moitra, On fish mortality in tanks and ponds of U.P., IV, 11.
- Das, S. M. and S. K. Moitra, On the correlation between fish-food and fish-gut in food fishes of U.P., IV, 10.
- Das, S. R., A Note on Domestic Painting of Bengal—'Alpana', III, 324.
- Das, S. K., A study of Manual Digital formula among the Pengalee and three South Indian Tribes, III, 320.
- Das, P. K. and R. B. Arora, Action of commonly used intravenous anaesthetics in Medical and Veterinary practice, on the Automaticity of Auriculo-Ventricular node, III, 337.
- Das, S. K., S. C. Mandal, A. B. Lal and H. N. Mukherjee, Studies on the nitrogen economy and aggregation of an upland soil of South Bihar, III, 368.
- Das, N. K. and D. P. Sadhu, Haematological Studies in Indian Goats, III, 347.
- Das, N. B. and Y. P. Gupta, Microbiological estimation of Thiamine in wheat, III, 370.
- Das, K. C. and M. K. Rout, Thiodiazolines. Part I—p-tolyl-imino thiodiazoline and its c-aryl derivatives, III, 113.
- Das, Bhaskar and M. K. Rout, Studies on Thiazolidones. Part I.—a-Naphthyl-Imino 4-Thiazolidone and its condensation products and use of one of these in the estimation of silver, III, 113.
- Das, Sisir Chandra, On the Effect of a Rigid spherical inclusion in a semi-Infinite Elastic Solid under stresses produced by a Couple on the plane boundary, III, 10.
- Das, S. N., On Liquid-Liquid Junction Potentials between some Uni-univalent Electrolytes, III, 110.
- Das, Nabinkishore, G. N. Mohapatra and M. K. Rout, Thiazole Derivatives and their Fungicidal action. Part I—2-substituted-amino 4-5-dimethyl thiazoles, III, 113.
- Das, J. N. and P. V. Khandekar, Study of the Current Voltage Characteristics of n-p Contacts in Galens, III, 33.
- Das, Bhagwan and D. Niyogi, Geology of the Area Around Simultala, Bihar, III, 177.
- Das, S. P. and B. Ghosh, Utilization of Neem Oil, III, 165.
- Das, J. P. and R. Rath, The factor of understanding in the judgment of literary passages in a Prestige suggestion experiment, III, 409.
- Dass, Bhagwan, Geomorphie history of the area in the Vicinity of Gaya, III, 211.
- Das, K. G. and P. P. Pillay, Chonemorphine : an alkaloid from the roots of *Chonemorpha macrophylla*, III, 130.

- Dass, Ranji and M. R. Verma, Two Dimensional paper Chromatographic method for Detection of Phenols in Bitumen, III, 80.
- Dass, Bhagwan, Geology of the area around Gaya (Bihar), III, 178.
- Das Gupta, S. C. and J. K. Choudhury, Harmonic Elimination Equipment, III, 421.
- Das Gupta, H. N. and M. R. Basu, Studies on South Arcot Lignite, III, 431.
- Dasgupta, B. and H. N. Ray, Occurrence of *Diplocytis* sp. as a parasite in the haemocoel of cockroach, III, 281.
- Dasgupta, B. and H. N. Ray, A note on the wall of the testis of bed-bug, III, 271.
- Dasgupta, B. and H. N. Ray, Observations on Rickettsia-like bodies in *Hyalomma savignyi*, III, 287.
- Dasgupta, B., A note on the campaniform sense-organs in *Hyalomma savignyi*, III, 287.
- Dasgupta, P., K. Sengupta and H. N. Ray, Studies on symbiotes occurring in the mid-gut epithelium of *Ctenolepisma longicaudata*, III, 289.
- Dasgupta, B. and H. N. Ray, Alkaline phosphate activity in the female reproductive tract of bed-bug, III, 271.
- Das Gupta, S. K. and D. Mukerji, A comparative study of the mouth-parts of ants, III, 290.
- Dasgupta, B., Observations on the accessory glands of the male bed-bug, III, 270.
- Dasgupta, B., Observations on the Oocytes of *Boophilus microplis*, III, 270.
- Das Gupta, Sivaraprasad, The Old Courses of the Bhagirathi River near Nabadwip (West Bengal), III, 213.
- Das-Gupta, S. N. and (Miss) Rachel John, Two species of *Chytridium* from Lucknow, III, 221.
- Das Gupta, A., A. K. Mishra and M. Purakayastha, Survey of antibiotic-producing actinomycetes from Indian Soils IV, III, 220.
- Das Gupta, S. P., Petrology of the Metamorphosed Basic and Ultrabasic Igneous Rocks of the area north of Birmitrapur, Sundargarh District, Orissa, III, 198.
- Das Gupta, S. K., J. K. Roy and A. K. Parua, Synthesis of 5, 6, 11, 12-Tetrahydrochrysene, III, 130.
- Das Gupta, S. P. and A. Goswami, On some sedimentological aspects of Hooghly river clay, III, 197.
- Datta, A. N., B. C. Kundu and P. Sanyal, Comparative Study on the Yield Performance on the Different Fibre Crops, III, 355.
- Datta, A. N., P. Sanyal and B. C. Kundu, Preliminary Studies on the Effect of Different Dates of Sowing in Mesta and Roselle, III, 258.
- Datta, Mridula, Mechanical adaptations to autonomous movements in *Desmodium Gyans* Linn. and *Oxalis repens* Linn., III, 235.
- Datta, R. M. and G. I. Patel, Cytogenetical Investigations of X-Ray induced mutations in the Jute (*Corchorus Olitorius* Linn.), III, 244.
- Datta, P. C., Studies on the Structure and Behaviour of Chromosomes of a Few Species of the Genus *Lathyrus*, as a means of Detecting the Interrelationship between the Species, III, 252.
- Datar, D. S. and Eshwar Raj Saxena, Separation of Sodium from Potash liquor from Felspar Employing Ion exchange Technique, III, 150.
- Datar, D. S. and Eshwar Raj Saxena, Pure Potassium Bromide from Nellore Felspar, III, 151.
- Datar, D. S. and T. L. Narasimha Rao, Active carbon from Coke obtained by low temperature carbonisation of Singreni Coal, III, 151.
- Datar D. S. and K. N. Moorthy, Action of steam on Chitaldrug (Mysore) Pyrites, III, 151.
- Datar, D. S. and Miss Akhtar Mohajir, Decomposition of Tricalcium Phosphate in presence of Sodium Carbonate and Alumina, III, 151.
- Datar, D. S. and T. L. Narasimha Rao, Studies on Vapour Adsorption by Active Carbons prepared from Indigenous Materials, III, 152.
- Datar, D. S. and T. L. Narasimha Rao, Studies on Caramel Decolorisation by Active Carbons from Indigenous Materials, III, 152.
- Datar, D. S. and Miss Akhtar Mohajir, Monocalcium Tetra Sodium Phosphate—Part II, 154.
- Datar, D. S. and Miss Akhtar Mohajir, Mono Calcium tetra sodium phosphate—Part I, III, 155.
- Datar, G. G. and D. V. Bal, The inter-relationships between total-length, standard length, body-weight and gonad-weight of *Megalopsis cordyla*, III, 301.
- Datta-Majumder, Nabendu, Some Pre-historic finds in Orissa, III, 321.
- Dave, A. S. and Sripadarao Kilpady, On the Occurrence of Beryl in Madhya Pradesh, III, 183.

- De, Deepesh and A. K. Sharma, Heterocyclic bases—an aspect of their use in Cytochemistry, III, 248.
- De, Deepesh and A. K. Sharma, Polyploidy in *Dioscorea*, III, 248.
- De, Kamini Kumar, On the instability of a single row of vortices of equal strengths alternatively positive and negative, III, 11.
- De, K. S. and S. K. Bhattacharyya, Thermal decomposition of Diazo-salt under pressure, III, 101.
- De, Aniruddha, Petrofabric Evolution in Zones of Regional Metamorphism around Kharsawan, Singbhum District, Bihar, III, 187.
- De, S. K., K. Pal, S. N. Luktuke and P. Bhattacharya, Studies on ascorbic acid content in the semen of hill bulls and buffalo bulls and its correlation with the seminal fructose and semen equality, III, 400.
- Deb, P. R., S. K. Basu and Amitava Pasu, A Study of Epiphysical Union in Long Bones of Bengalee Adolescents, III, 327.
- Deb, S., Geology of the ground water relations, revealed from the bore-hole records at the Contai Sea Coast of West Bengal, III, 209.
- Deb, Arup and V. S. Dubey, The Study of the Geology and Petrology and the Economic Resources of Barwaha, Madhya Bharat, III, 175.
- Deekshitulu, M. N. and P. Perraju, Chromite Deposits of Maruabil, Dhenkanal district, Orissa, III, 207.
- Deekshitulu, M. N., On the emplacement of Chromite in Quartzite near Ghotringa, Dhenkanal district, III, 204.
- Dehai-Kulkarni, V. M. and R. V. Joshi, Characteristic features of the drainage around Dharwar (Bombay State), III, 212.
- Deka, Usha, S. S. Sarkar and K. K. Agarwal, Brachycephaly in India, III, 319.
- Demographic Problems, IV, 36.
- Deoras, P. J. and K. V. Tempi, Some External Insect Parasites of Rat in Bombay, III, 289.
- Desarkar, B. K. and B. K. Kar, Dual purpose of Growing Jute for Fibre and Seeds, III, 356.
- Desai, D. D., M. V. Shingre, and N. R. Tawde, Transition Probabilities in bands of Blue-green system of TiO by numerical integration methods of Bates and of Pillows, IV, 5.
- Desai, N. D. and N. R. Bhat, Genetic Investigations of the 'Whorled' Mutant in *Gossypium herbaceum*, III, 245.
- Desai, M. H. and Taralochan Singh, Attempts for the Manufacture of Ultramarine blue, III, 173.
- Desai, N. J. and Suresh Sethna, Synthesis of 4-hydroxycoumarin derivatives, III, 115.
- Deo, P. G. and H. D. Srivastava, Studies on the effect of multiple primary infections upon a subsequent infection of *Ascaridia galli*, Scharank, 1788, in Chickens, III, 346.
- Deo, P. G. and H. D. Srivastava, Studies on the biology and life-history of *Ascaridia galli*, Scharank, 1788, III, 282.
- Deo, P. G., Etching of metal and alloy crystals under cathodic sputtering, III 34. and B-dichloro phenyl propionic acids, III, 117.
- Devasthale, V. V. and K. S. Nargund, Preparation of dichloro propiophenones B-dichloro phenyl propionic acids, III, 117.
- Deshpande, P. and R. J. Kalamkar, Investigations into the effect of green manuring of cotton and its residual effect on subsequent crop of grain juar, III, 358.
- Deshpande, T. L., D. K. Ballal and R. J. Kalamkar, Effect of growing cotton in rotation with the different crops on structure of black cotton soil, III, 363.
- Deshpande, D. M. and K. K. Dhole, Studies in the Film Properties of D. C. O. Varnishes, III, 153.
- Deshpande, L. V., Two simple methods for studying elliptically polarized light with Babinet's Compensator (Jamin type), III, 26.
- Deshpande, C. M. and S. K. K. Jatkar, Dielectric Constant of Liquids and Dipole Moment, Aldehydes (part III), III, 34.
- Deshpande, D. D. and S. K. K. Jatkar, Resonance Energy and Ultrasonic Dispersion from Molecular Spectra, III, 34.
- Deshpande V. V., C. R. Kanekar and R. M. Mathur, Susceptibility of CH_2 and Hybridisation of Carbon, III, 93.
- Deshpande, G. G. and Sripadrao Kalipady, The Heavy-V Minerals of the Kamthi Sandstones, III, 186.
- Deva, B. Chaitanya, C. R. Sankaran and P. C. Ganeshsundaram, Reversed Speech and the Alpha-phoneme Theory, IV, 18.
- Devi, Anima and B. B. Ghosh, Mode of action of cations on isolated Toad's Heart, III, 390.

- Devi, Padmini, Studies in Leaf form on venation of Vascular Plants—II (Verbenaceae), III, 228.
- Dewagan, A. S. and A. N. Kappanna, An Electrolytic Study of Aqueous Lead Formate Solutions, III, 88.
- Dey, B. B. and H. V. K. Udupa, A New Technique in Electrolytic Practice, IV, 6.
- Dey, L. M. and S. P. Pathak, Component Fatty Acids of the Seed fat of *Pongamia Glabera* (Karanja), III, 160.
- Dey, M. N. and D. Mukerji, Morphology and anatomy of the cigarette beetle, *Lasioderma serricorne* (Fab.), III, 290.
- Dhami, D. S. and B. N. Mulay, Microsporangium, Microsporogenesis and Male Gametophyte of *Mimosa Rubicaulis* Lamb, III, 227.
- Dhar, A. N., Cation Exchange Resins from Shellac, III, 100.
- Dhar, A. N., Cation Exchanger from Saw dust, III, 99.
- Dhingra, D. R., S. N. Dhingra and G. N. Gupta, Essential oil of *Eupatorium Odorum*, Linn, III, 162.
- Dhingra D. R., S. N. Dhingra and G. N. Gupta, Thio-urea complexes of Essential Oil, III, 163.
- Dhingra, D. R., G. N. Gupta and Ganesh Chandra, The Indian Otto of Rose, III, 164.
- Dhingra, S. N., D. R. Dhingra and G. N. Gupta, Essential oil of *Eupatorium Odorum* Linn, III, 162.
- Dhingra, S. N., D. R. Dhingra and G. N. Gupta, Thio-urea complexes of Essential Oils, III, 163.
- Dhindsa, K. S. and G. P. Sharma, Spermatogenesis of the Toad (*Bufo stomaticus*—“Lutkin”) with particular reference to the Cytoplasmic inclusions, III, 274.
- Dixit, K. K. and Dora Ilse, Experiments and observations on an Indian Dammar Bee *Mehpona irridipennis*, III, 299.
- Dixit, S. N., The female gametophyte to *Lepeostegeres gamuiflorus* Bl., III, 235.
- Dixit, V. M. and P. R. Ravikiran, Phosphorus oxychloride as condensing agent for the Pechmann Reaction: Phenolic esters of coumarin-4-acetic acids, III, 133.
- Dixit, V. M. and B. R. Ravikiran, BB-Diaryl glutric acid from phenol, III, 125.
- Doja, M. Q. and Arun Kumar Sinha, Synthesis of cyanine dyes by the condensation of p-dialkylaminobenzaldehyde with appropriate heterocyclic compounds. Part VI, III, 119.
- Dole, K. K. and D. M. Despande, Studies in the Film Properties of D. C. O. Varnishes, III, 153.
- Dole, K. K. and V. R. Ambekar, Studies on the Solubility of Dehydrated Castor Oil, III, 154.
- Dole, K. K. and V. A. Saraf, Dehydration of Castor Oil with Phenol Trisulphonic Acid as Catalyst, III, 154.
- Dole, K. K. and P. K. Godbole, Study of Active Charcoal prepared from *Euphorbia Tirucalli* L. (Sher), III, 153.
- Dole, K. K. and V. R. Keskar, Thermal Polymerization of Dehydrated Castor Oil.—II, III, 153.
- Dole, K. K. and S. V. Pingle, Adsorption and Desorption of Organic Molecular Compounds, III, 94.
- Dole, K. K. and P. S. Kulkarni, Investigations in Viscosity of Milks. Part VII—Viscosity of Milk and Adulteration (by added water), III, 81.
- Dosajh, N. L., An Electrical ‘Reaction Time’ Apparatus, III, 405.
- Dubey, A. S. and B. Samantarai, Induction of Drought Resistance in Rice Plants, III, 258.
- Dubey, K. C., A Study of Bundelkhand Granites and the Associated Rocks around Heerapur in the North-eastern Corner of Sagar District, Madhya Pradesh, III, 195.
- Dubey, K. C., G. W. Chiplonkar and P. S. Agarkar, A Preliminary Note on Petrography of the area Jhansi, III, 186.
- Dubey, K. C., A Note on the Quartz-veinlets in the Bijawar Limestone, Heerapur, Sagar District, Madhya Pradesh, III, 195.
- Dubey, V. S. and Arup Deb, The Study of the Geology and Petrology and the Economic Resources of Baiwaha, Madhya Bharat, III, 175.
- Dubey, V. S. Radioactivity of Mt. Girnar Rocks and the Distribution of the Radioactivity on Differentiation, III, 201.
- Dubey, V. S., A Tectonic Analysis of the Quartz Reefs in the Metamorphite of Tilatanr. Tetulmari (Dhanbad), III, 202.
- Dubey, V. S., Radioactivity of the Pasic Igneous Rocks of the Bijawar Period and the Question of their Age by Helium Method and its Bearing on the age of the Delhi's and the Vindhya's, III, 200.

- Dutt, S. C. and H. D. Srivastava, Toxicity of certain chemicals to the miracidia and cercariae of *Schistosoma indicum* and *Orientobilharzia dattai*, III, 351.
- Dutt, S. C. and H. D. Srivastava, Life history of *Schistosoma indicum* Montgomery, 1906,—a common blood-fluke of Indian ungulates, III, 354.
- Dutt, S. C. and H. D. Srivastava, Biological studies on *Schistosoma indicum* Montgomery, 1906—a common blood-fluke of Indian ungulates, III, 353.
- Dutt, S. C. and H. D. Srivastava, Studies on the Life History of *Orientobilharzia dattai* (Dutt & Srivastava, 1952) n.comb.—a blood-fluke of domestic mammals, III, 350.
- Dutt, S. C. and Srivastava, Biological studies on *Orientobilharzia dattai* (Dutt & Srivastava, 1952)—a blood-fluke of domestic mammals, III, 351.
- Dutt, S. C. and K. N. Mehra, Studies on the life history of *Hymenolepis farcinosa* (Goeze, 1782), a tapeworm of crow and collard myna, III, 283.
- Dutt, S. C. and H. D. Srivastava, A revision of the genus *Ornithobilharzia* Obhner, 1912. (Trematoda: Schistosomatidae), III, 283.
- Dutt, B. C. and S. K. Nandi, Fine Crushing of CoCal in Ball Mill, III, 414.
- Dutta, B. N., H. G. Sen and H. N. Ray, Anttrycide as a trypanocidal drug, III, 336.
- Dutta, Pratap Chandra, Typological Parallelism between Stellenbosch (South Africa) and Mayurbhanj (India) Tools, III, 322.
- Dutta, B. N. and H. N. Ray, Effect of Newer Antimalarials on the Morphology of Human Malaria Parasites, III, 332.
- Dutta, B. N., H. C. Sen and H. N. Ray, Effect of Milk diet in *Trypanosoma evansi* infections in rats, III, 335.
- Dutta, P. N., H. N. Ray and H. G. Sen, Evidence of Alkaline and Acid phosphatase enzymes in *Trypanosoma evansi*, III, 271.
- Dutta, B. N., H. N. Ray and H. G. Sen, Occurrence of Mucopolysaccharides in *Trypanosoma evansi*, III, 272.
- Dutt, Arunabha and A. K. Sharma, Induction of Chromosome Division through Asorbic Acid Treatment, III, 249.
- Dutta, Arun Kanti and B. K. Mukherji, Studies on Sulphonation of Modified Oils, III, 150.
- Dutta, Jadugopal and Bidyut Kamal Bhattacharyya, Sitosterols from *Mimosa pudica* Linn, III, 141.
- Dutta, P. C., Experiments towards the synthesis of Santonin or its stereoisomers, III, 141.
- Dutta, N. L., Chemical Study of the Saponins from *Entada scandens*, Benth (Gila), III, 138.
- Dutta, Saktipada and T. N. Ghosh, Search for New Antispasmodics, Part VII, III, 134.
- Dutta, J. and D. N. Lal, A system of orthogonal polynomials, III, 15.
- Dutta, S. N., P. N. Sharma and S. R. Bhattacharya, Study of Electrolytic Dissociation by X-Ray diffraction—II, III, 35.
- Dutta, N. L., Chemical Study of the Saponins from *Entada scandens*, Benth (Gila), III, 138.

E

- Esh, G. C., Studies on the Nutritive Value of Plant Proteins, Part II. Influence of Vitamin B₁₂ on the nutritive value of Pulse Proteins, III, 385.
- Effect of Growth Promoting substances on crop production, IV, 74.
- Evolution of Continents, IV, 72.

F

- Fadnis, B. S., Axisymmetric Flow in perfect Fluid. Motion of a spheroid along the axis of a rotating liquid, III, 12.

G

- Galagali, R. J. and H. J. Arnika, The 'Corona Pressure' and the Thermionic Analogue of Joshi Effect in Hydrogen, III, 32.
- Galagali, R. J. and H. J. Arnika, Effect of Aging under discharge of the Resistance of Platinum Electrode, III, 32.
- Ganapati, P. N. and K. Hanumantha Rao, On the occurrence of Metacercariae cysts of a Diplostome (Trematoda) in Fresh-water Fishes, III, 285.

- Ganapati, P. N. and R. Nagabhushanam, Biology of Some Marine Wood Boring Organisms of Visakhapatnam Harbour, III, 315.
- Gnanapragasam, N. S., Lourdu M. Yeddanapalli and R. Ganesan, Halogenation of Phenol with Iodine Bromide in Acetic Acid, III, 111.
- Ganesan, R. and R. Srinivasan, Effluents from the Erode Cauvery Textiles Limited Bhavani, and their effect on the fisheries of the Cauvery river, III, 305.
- Ganesan, R., Lourdu Yeddanapalli and N. S. Gnanapragasam, Halogenation of Phenol with Iodine Bromide in Acetic Acid, III, 111.
- Ganeshsundaram, P. C., C. R. Sankaran and B. Chaitanya Deva, Reversed Speech and the Alpha-phoneme Theory, IV, 18.
- Ganguly, D. N., H. K. Mookherji and B. D. Hajra, On the functional morphology of the organs concerned with intake of food of some teleostean fishes in relation to their feeding habit: Topography of the facial portion and gross anatomy and histology of lips and barbels, III, 303.
- Ganguly, D. N., H. K. Mookherjee and S. K. Das, On the structure and development of the Weberian apparatus in a Silurid fish, *Silundia gangetica*, III, 303.
- Ganguly, D. N., H. K. Mookherjee and T. P. Chatterjee, On the development of the notochord and the vertebral column in Cyprinodont, *Orisias melastigma* (McClelland), III, 278.
- Ganguly, N. C. and S. C. Roy, Concentration of some B-vitamins in the Liver Tissue of Rats under Chloretone, III, 146.
- Ganguly, S. and S. C. Roy, Amino acid composition of the mycelia of *Streptomyces griseus* formed during its production of vitamin B₁₂, III, 146.
- Ganguly, D., R. C. Basu Roy Choudhury and M. N. Goswami, Studies on the Nutritive value of synthetic Glycerides, III, 144.
- Ganguly, D., R. Basu Roy Choudhury, Samir Sarkar and M. N. Goswami, Studies on the preparation of Monoglycerides: Direct esterification of fatty acids and glycerol, III, 124.
- Ganguly, S. K. and B. K. Moza, An investigation on the Glycosides of *Digitalis lanata* Ehrh. grown in Kashmir. Part I, III, 134.
- Ganguly, N. K. and A. M. Ghosh, The Absorption Coefficients of Co60 Gamma-Ray, III, 33.
- Ganguly, D., S. Sarkar, R. C. Basu Roy Choudhury and M. N. Goswami, Purification of Technical Monoglycerides, III, 164.
- Ganguly, D., R. Basu Roy Choudhury and M. N. Goswami, Investigations on Reclamation of Rancid Food Fats, III, 165.
- Ganguli, Harish Chandra, A further Analysis of Relation of Union-membership to Attitude of Industrial Workers, III, 412.
- Ganguli, M. K. and H. Rammurthy, Salinity pattern in the river Hooghly, III, 20.
- Ganguli, N. C. and S. C. Roy, Amino Acid composition of different tissues of rat under chloretone, III, 142.
- Gaur, H. C., The Role of 'Ageing' in the Production of Joshi Effect in Mercury Vapour, III, 97.
- Gaur, H. C. and N. A. Ramaiah, On Geiger Region of A/C Electric Discharge, III, 30.
- George, E. C., Entropy and Specific Heat of Liquid He³, IV, 3.
- George, J. C., On the Significance of the Action of the Bile Salt Sodium Taurocholate on Marine Eggs, III, 280.
- George, J. C. and R. V. Shah, Respiratory Mechanism in the Chelonia, IV, 10.
- Ghaisas, V. V. and B. D. Tilak, Thiophene Isomers of Carcinogenic Hydrocarbons, III, 114.
- Ghanekar, Miss D. S., D. V. Bal and Mrs. K. Sohoni, The Enzymes of Some Elasmobranchs from Bombay: Amylases, III, 302.
- Ghosh, A. B. and S. P. Raychaudhuri, Fertilizer use of ammonium chloride and ammonium sulphate-nitrate (Leunasalpeter) as sources of nitrogen to paddy and wheat, III, 358.
- Ghosh, H., H. N. Chatterjee, K. K. Chatterjee, R. K. Saha, R. Banerjee and D. K. Ghosh, A Study of Pyrexia and some febrile other Inflammatory Complications of Cholera, III, 332.
- Ghosh, A. B., M. A. Idnani, R. K. Chibber and M. B. Sengupta, Fertilizer value of Dicalcium phosphate in non-acid calcareous soils of India, III, 364.
- Ghosh, D. K., K. K. Chatterjee, H. N. Chatterjee, R. K. Saha, R. Banerjee and H. Ghosh, A Study of Pyrexia and some febrile other Inflammatory Complications of Cholera, III, 332.
- Ghosh, Manasi and P. Maheshwari, The Systematic Position of *Exocarpus*, III, 234.
- Ghosh, A. K. and Nirad K. Sen, Study of Karyotype of Common Pulses, III, 247.
- Ghosh, T. N. and Saktipada Dutta, Search for New Antispasmodics: Part VII, III, 134.
- Ghosh, P. K., Some Consequences of a Theorem of Darboux, III, 6.

- Ghosh, J. C. and M. S. Muthna, Studies on Walden inversion: Kinetics of the conversion of l-Bromo succinic acid to d-B malo lactonic acid (Part I); and Hydrolysis of d-B, malo lactonic acid to l- or d- malic acid (Part II), III, 125.
- Ghosh, S. B., G. P. Sen and P. Nandi, Studies on counter-current distribution and applications, Part II, 100.
- Ghosh, A. R. and A. N. Roy, Influence of Foaming agent on the Velocity of Reduction of Haematite with Hydrogen, III, 91.
- Ghosh, J. C., M. V. C. Shastri and T. S. Viswanathan, Reaction in the substrate formed on a Cobalt Fischer-Tropsch catalyst, III, 104.
- Ghosh, S. P. and A. K. Banerjee, Complex Compounds Silver (II) with p-Phenetyl
- Ghosh, M. N., Estimation of linear structural parameters, III, 16.
- Ghosh, S. P. and H. M. Ghose, Estimation of Cobalt by Benzimidazole, III, 79.
- Ghosh, B. N. and D. K. Sen, The Evaluation of Rate Constants of First-Order irreversible Reactions with the help of Alignment Chart—Part I, III, 94.
- Ghosh, A. K. and B. Bose, Spores from Cambrian and pre-Cambrian beds of India and U.S.A., III, 267.
- Ghosh, S. and R. S. Rai, Studies in the change of Hydrogen Ion concentration of Colloidal Ferric Hydrous Oxide Sol during its coagulation by Potassium Sulphate, III, 109.
- Ghosh N. N., On the Solution of T's for a Type of Non-Static Unitary Field giv., III, 8.
- Ghosh P. and S. P. Das, Utilization of Neem Oil, III, 165.
- Ghosh Mrinmayee, Determination of the F-Region collisional frequency over Calcutta, III, 24.
- Ghosh, A. M. and N. K. Ganguly, The Absorption Coefficients of Co_α, Gamma-Ray, III, 33.
- Ghosh, A. B., M. B. Sengupta and S. P. Raychaudhuri, Semi-acidulated rock-phosphate as a phosphatic fertilizer for wheat in calcareous soils, III, 366.
- Ghosh, D. P. and B. N. Chowdhuri, Local Anaesthetic Effects of Mephenesin, III, 396.
- Ghosh, R., N. K. Sarkar and S. R. Maitra, Existence of a Cardio-stimulating Factor in Cobra Venom, III, 391.
- Ghosh, B. B. and Anima Devi, Mode of action of cations on isolated Toad's Heart, III, 390.
- Ghosh, A. B., M. A. Idnani and R. K. Chibber, Effect of dipping paddy seedlings in nutrient solutions before transplanting, III, 375.
- Ghose, Bhabani Charan, Wilms Tumour, III, 328.
- Ghose, Subrata, Heavy Mineral study and Subdivision of Lower Barakars of Tisra area—Jharia Coalfield, III, 207.
- Ghose, H. M. and S. P. Ghosh, Estimation of Cobalt by Penzimidazole, III, 79.
- Godavari, (Miss) C. P., On the Anatomy of the Acclimatised Conifers of South India, III, 222.
- Godbole, P. K. and K. K. Dole, Study of Active Charcoal prepared from Euphorbia Tirucalli L. (Fler), III, 153.
- Gogate, D. V. and H. N. Patil, A Study of temperature Variation in convected Air-streams, III, 37.
- Gopalakrishna, A., Sex-cycle in Taphozous longimanus (Hardwicke) Microhiroptera, III, 312.
- Gopalakrishna, V. V. and Lourdu M. Yeddanapalli, Autoxidation of the Monophenol from Commercial Cashew Nut Shell Liquid and of its Methyl Ether, III, 131.
- Gore, K. G. and M. G. Marathey, Synthesis of Dihydroflavonols and Flavonols. Part IV: Synthesis of bromoflavonols, III, 118.
- Gore, K. G., M. G. Marathey and J. M. Athavale, Synthesis of Dihydro Flavonol and Flavonols, Part V: Synthesis of 5:6-substituted flavonols, III, 119.
- Gore, K. G. and M. G. Marathey, Synthesis of 4-methyl-6-ethyl-2'-phenyl comparin-7:8-y-pyrone, III, 118.
- Goswami, A., Geology of the area around Mandu, Hazaribagh District, Bihar, III, 180.
- Goswami, G. C., A. Saikia and P. C. Goswami, Influence of Inorganic Salts on the R Values of Amino Acids, IV, 6.
- Goswami, M. N., R. C. Basu Roy Chondhury and D. Ganguly, Studies on the Nutritive value of Synthetic Glycerides, III, 144.
- Goswami, A. and S. P. Das Gupta, On some sedimentological aspects of Hooghly river clay, III, 197.
- Goswami, A., On the occurrence and beneficiation of Coal from the West Bokaro Coalfield, Hazaribagh District, Bihar, III, 206.

- Goswami, G. C. and P. N. Bhargava, Studies on 3-m-tolyl-2-m-tolylimino-4-thiazolidone, III, 122.
- Goswami, P. C., G. C. Goswami and A. Saikia, Influence of Inorganic Salts on the RF Values of Amino Acids, IV, 6.
- Goswami, M. N. and S. K. Chakravarti, Thiocyanometric Titrations Catalysed with Mercuric Salts, III, 78.
- Goswami, M. N., S. Sarkar, R. C. Basu Roy Choudhury and D. Ganguly, Purification of Technical Monoglycerides, III, 164.
- Goswami, M. N., D. Ganguly and R. Basu Roy Choudhury, Investigations on Reclamation of Rancid Food Fats, III, 165.
- Goswami, M. N., R. Basu Roy Choudhury, D. Ganguly and Samir Sarkar, Studies on the preparation of Monoglycerides : Direct esterification of fatty acids and glycerol, III, 124.
- Goswami, S. K., A New Voluntary Muscle Relaxant, IV, 19.
- Govindarajan, S. V. and P. V. Venkata Rao, Influence of phosphorus on nitrogen utilisation by Ragi Crop, III, 368.
- Govindarajan, S. V. and B. V. Venkata Rao, Liquid Ammonia as Fertilizer—some preliminary soil studies on Nitrogen Transformations, III, 368.
- Gowda, S. S., New "frontier" in the Micropalaeontology of the Trichinopoly marine beds, IV, 9.
- Guha, (Mrs.) Mitra and A. B. Chatterji, An Urban Study of a Stellite Town, Calcutta, III, 215.
- Guha, U., Attitude of U.P. Village Women of Purdah and Divorce, III, 324.
- Gulati, I. B. and S. K. Bhattacharyya, Differential Thermal analysis of promoted Silver Oxide Catalysts, III, 100.
- Guplati, I. B. and S. K. Bhattacharyya, Catalytic Vapour Phase Oxidation of Ortho Xylene, Part II, III, 166.
- Gulati, I. B. and D. Venkateswarlu, Submerged Combustion, III, 414.
- Gun, A. M., On the standard error of the coefficient of belonging, III, 16.
- Gupta, R. L. and R. R. Rawat, Bionomics of Wax-moth *Galleria mellonella* Linn., III, 379.
- Gupta, Y. P. and N. B. Das, Essential amino-acid contents of legumes and grasses (Methionine, Cystine and Tryptophane), III, 375.
- Gupta, R. L., Linseed Gall Fly (*Dasynura lini* Barnes) and Its Control, III, 381.
- Gupta, R. L., Life History of *Laspeyresia pseudonectis* Meyr., III, 380.
- Gupta, Y. P. and N. B. Das, Microbiological estimation of Thiamine in Wheat, III, 370.
- Gupta, S. Y., Some Observations on the Abnormalities of Tacoma Stans, III, 225.
- Gupta, B., Micrometry of Woolly Leaves of *Hyoecyamus muticus* Linn, III, 238.
- Gupta, G. N., B. Biswas and V. N. Nigam, Preparation of activated carbon from Kans (*Saccharum spontaneum*), III, 169.
- Gupta, G. N., Ganesh Chandra and S. T. H. Zaidi, Dill seeds and herb oils, III, 167.
- Gupta, J. S., Chromatographic Identification of Soluble sugars in Healthy and Diseased seeds of *Coriandrum Sativum* L. affected by *Protomyces Macrosporus* Ung., III, 221.
- Gupta, R. L., Linseed Gall Fly (*Dasynura lini* Barnes) and its Control, II, 294.
- Gupta, G. N. and I. N. Tandon, Essential Oil of Ajowan Seeds and herb, III, 167.
- Gupta, Purna Chandra and Ram Das Tewari, Chemical Examination of the Colouring matters from the seeds of *Cassia-tora*, III, 142.
- Gupta, S. L., Effect of indifferent electrolyte on the behaviour of surface active substances on the dropping mercury electrode capacity, III, 98.
- Gupta, G. N., S. N. Dhingra and D. R. Dhingra, Essential oil of *Eupatorium Odorum*, Linn, III, 162.
- Gupta, G. N., Ganesh Chandra and D. R. Dhingra, The India Otto of Rose, III, 164.
- Gupta, G. N., S. N. Dhingra and D. R. Dhingra, Thio-urea complexes of Essential Oils, III, 163.
- Gupta, R. L., Life history of *Laspeyresia pseudonectis* Meyr., III, 294.
- Gupta, R. L. and R. R. Rawat, Bionomics of Wax-moth *Galleria mellonella* Linn., III, 379.
- Gupta, T. C., Subclavian aortic shunt in experimental coarctation in Dogs, IV, 18.
- Gutam, A. N. and L. D. Ahuja, A Study of Variation in Putter fat content of a Herd Milk pool for the Haryana Breed, II, 342.
- Gvani, B. P. and Miss Rani Misra, Some Salt of Iron with Organic Acids, III, 91.
- Gyani, B. P. and Miss Rani Misra, The Reaction between Chloride and Ammonium Thiocyanate—Part II, III, 90.
- Gyani, B. P. and Miss Rani Misra, The behaviour of Ferric Chloride in Organic Solvents, III, 90.

- Gyani, B. P. and S. N. Prasad, Reduction of Potassium Permanganate by Iodide and Bromide ions in Presence of Sulphuric Acid, III, 90.
 Gyani, B. P., M. Murari and A. C. Roy, Oil and Tannin from *Caesalpinia Digyna* (Teri), III, 260.
 Gyani, B. P. and Madan Murari, Viscosity and Critical Solution Temperatures of some Oil Mixtures, III, 148.
 Gayen, A. K., The product-moment correlation and the reliability coefficient, III, 16.
 Gayen, A. K., Reliability and Validity of School Examinations, III, 411.

H

- Haider, S. Z. and E. S. Narayanan, Some Biological Factors influencing the sex-ratio in *Bracon* (*Microbracon*) *gelechia* Ashmead (Hymenoptera : Braconidae), A Larval parasite of the Potato Tuber Moth, *Gnorimoschema* (*Phthorimaca*) *operculella* (Lepidoptera : Gelechiidae), III, 382.
 Hajra, Bansidhar and Sivatosh Mookherjee, Cytic Viability of Soil Amoebae, III, 281.
 Hajra, Bansidhar and Sivatosh Mookherjee, Compositional changes during Phase variation of Amoebae, III, 273.
 Hajra, B. D., H. K. Mookherjee and D. N. Ganguly, On the functional morphology of the organs concerned with intake of food of some teleostean fishes in relation to their feeding habit : Topography of the facial portion and gross anatomy and histology of lips and barbels, III, 303.
 Halder, G., B. C. Kundu and M. K. Mukherjee, A Short note on the Growth of Jute (*C. Capsularis*—D 154) with Fertilisers under water-logged conditions, III, 354.
 Halder, G. and A. K. Kundu, A note of the Biochemical changes during retting of Jute, III, 369.
 Halder, G., M. K. Mukherjee, S. C. Chakravorty and A. K. Kundu, Jute leaves as manures : I : Influence on the growth of paddy, III, 360.
 Halder, G., B. C. Kundu, M. K. Mukherjee and A. K. Kundu, Retting of Jute : III : Shortening of Retting Period by Means of Chemical Activities, III, 377.
 Harwalkar, V. R. and S. A. Saletore, Studies on storage of Indian Cotton seed and oil : Part I, III, 132.
 Hasan, Masudul and S. M. Tahir Rizvi, The Geographical Background of the Location of Cottage Industries in Uttar Pradesh, IV, 7.
 Hazra, P. C. and Y. G. K. Murty, A Note on the occurrence of Ellipoidal Lava near Kantanali, Sundargarh district, Orissa, III, 185.
 Hazra, P. C. and K. N. Prasad, Some observations on the stratigraphy and tectonics of the region north of the Panihal Pass, Kashmir, III, 179.
 Hiregaudar, L. S. and S. Rammohan Rao, A Note on *Syringophilus Bipectinatus* (Heller, 1880)—A Quill Mite of Domestic Fowl in India, III, 354.
 Hiregaudar, L. S. and S. R. Rao, A Note on the little known forms of *Taenia Cyclophlidae*, III, 350.
 Hiregaudar, L. S. and S. Rammohan Rao, A New Species of Trombiculid Mite from a rat snake in Bombay, III, 287.
 Honrao, M. S. and R. V. Joshi, Occurrence of Quartzite Bank near Karwar, (Bombay State), III, 193.
 Honrao, M. S. and V. R. Prabhu, A study in Coastal Settlements, North Kanara District, Bombay State, IV, 9.
 Hora, Sunder Lal, Fisheries of Certain Tropical Fishes in Natural Cold of India, III, 302.
 Hora, Sunder Lal, Some Interesting features of the Aquatic Fauna of the Kashmir Valley, III, 317.
 Hore, Pramathanath, Natural Religions of India—a Problem for the Indian Geographers, IV, 8.
 Hulyalkar, R. K., T. R. Ingle and B. V. Bhide, Chemical investigation of the gum khair. (*Acacia catechu* : N. O. Leguminosae) Part II :—Structure of the aldo-bionic acid, III, 139.
 Hulyalkar, R. K., T. R. Ingle and B. V. Bhide, Chemical investigation of "khair gum". (*Acacia catechu*, N. O. Leguminosae) Part I :—Composition of the khair gum, III, 139.
 Hulyalkar, R. K., T. R. Ingle and B. V. Bhide, Chemical investigation of the gum khair. (*Acacia catechu*, N. O. Leguminosae) Part II :—Structure of the aldo-bionic acid, III, 139.
 Hulyalkar, R. K., T. R. Ingle and B. V. Bhide, Chemical investigation of "khair gum" (*Acacia catechu* : N. O. Leguminosae) Part I :—Composition of the khair gum, III, 139.

I

- Idnani, M. A., A. B. Ghosh and R. K. Chibber, Effect of dipping paddy seedlings in nutrient solutions before transplanting, III, 375.
- Idnani, M. A., A. B. Ghosh, R. K. Chibber and M. B. Sengupta, Fertilizer value of the Dicalcium phosphate in non-acid calcareous soils of India, III, 364.
- Ilse, Dora and K. K. Dixit, Experiments and observations on an Indian Dammar Bee *Melipona irridipennis*, III, 299.
- Ingle, T. R., R. K. K. Hulvarkar and B. V. Bhide, Chemical investigation of the gum khair. (*Acacia catechu*; N. O. Leguminosae) Part II:—Structure of the aldo-bionic acid, III, 139.
- Ingle, T. R., V. M. Parikh and B. V. Bhide, Chemical investigation of Modal Gum. (*Lanata grandis*; N. O. Anacardiaceae), Part I:—Composition of Modal gum, III, 140.
- Ingle, T. R., V. M. Parikh and B. V. Bhide, Chemical investigation of "Bael mucilage". (*Aegle marmelos*; N. O. Rutaceae) Part I:—Composition of Bael mucilage, III, 140.
- Ingle, T. R., R. K. Hulvarkar and B. V. Bhide, Chemical investigation of "khair gum", (*Acacia catechu*, N. O. Leguminosae) Part I:—Composition of the khair gum, III, 139.
- Ingle, T. R., V. M. Parikh and B. V. Bhide, Chemical investigation of Modal Gum. (*Lannea grandis*; N. O. Anacardiaceae) Part II:—Structure of the aldo-bionic acid, III, 140.
- Ingle, T. R., R. K. Hulvarkar and B. V. Bhide, Chemical investigation of the gum khair. (*Acacia catechu*; N. O. Leguminosae) Part II:—Structure of the aldo-bionic acid, III, 139.
- Ingle, T. R., V. M. Parikh and B. V. Bhide, Chemical investigation of Modal Gum. (*Lannea grandis*; N. O. Anacardiaceae) Part I:—Composition of Modal gum, III, 140.
- Ingle, T. R., V. M. Parikh and B. V. Bhide, Chemical investigation of "Bael mucilage". (*Aegle marmelos*; N. O. Rutaceae) Part I:—Composition of Bael mucilage, III, 140.
- Interrelation of Protein and Vitamins, IV, 127.
- Iyengar, V. K. Sundaresa, T. Subramania Pillai and M. D. Parthasarathy, Histological and H. stochemical Studies on the Coaxal glands of *Palameus gravis* Thorell, III, 269.
- Iyengar, N. K., B. N. Chowdhuri, M. D. Chakravarti and S. Bhattacharya, Quality of Liver injections, III, 402.
- Iyer, S. G., S. Bose and H. P. Tandon, Studies on the Utilisation of Vitamin B₁₂ and Antibiotics in Poultry Feed, III, 344.
- Iyer, S. G., H. P. Tandon and S. Bose, Studies on Pp-grading of Indian Poultry, III, 345.
- Iyer, S. G., S. Bose and H. P. Tandon, Economics of Different Breeds with Reference to Eggs Production, VIII, 344.
- Iyer, S. G. and H. P. Tandon, Influence of Body Weight of Pullets on Fecundity, III, 345.
- Iyer, S. G., S. Bose and H. P. Tandon, Experiments with Built up Litter for Raising Chickens, III, 343.
- Iyer, S. G., S. Bose and A. K. Pal, Studies on the Effect of the Addition of Yeast Sludge in Normal and Simplified Laying Rations, III, 344.

J

- Jagatap, P. N., G. W. Chiplonkar and B. R. Patel, A Preliminary Note on the Dykes of Hirapur-Narwa area in Saugor District, Madhya Pradesh, III, 203.
- Jain, M. K., Boundary Layer effects in Non-Newtonian Fluids, III, 11.
- Jain, A. P. and R. Verma, The Petrography of the Granites and Associated Khondalitic Rocks near Ranchi, Bihar, III, 187.
- Jaiswal, Ganeshpershad, On a new species of trematode belonging to the genus *Philonthalmus* Looss, 1899, from the eyes of Bird in Hyderabad-Deccan, IV, 10.
- Jambunathan, M. V., Generalisation of a theorem on optimum allocation, III, 18.
- Jambunathan, M. V., The intra-class correlation from a new angle, III, 18.
- Jana, Hrishikesh, Ajit Maiti and B. B. Sarkar, Effect of Kuksine on the Haematological studies of rabbits, III, 396.
- Jatkar, S. K. K. and D. S. Bendale, Utilisation of Agricultural Waste, III, 169.

- Jatkar, S. K. K. and B. N. Mattoo, Studies on Karanja Oil : Spectrophotometric Investigation of the Unsaponifiable Matter, III, 168.
- Jatkar, S. K. K. and K. A. Khasgiwale, The Potentiometric study of Double Salts, III, 107.
- Jatkar, S. K. K. and B. N. Mattoo, Absorption Spectra of Coumarins, III, 108.
- Jatkar, S. K. K. and D. D. Deshpande, Resonance Energy and Ultrasonic Dispersion from Molecular Spectra, III, 34.
- Jatkar, S. K. K. and S. M. Jogdeo, Studies of the Complex Metal Cyanides in Solution, III, 86.
- Jatkar, S. K. K. and K. A. Khasgiwale, The Potentiometric Study of Metal Amines, III, 85.
- Jatkar, S. K. K. and C. M. Deshpande, Dielectric Constant of Liquids and Dipole Moment, Aldehydes (part III), III, 34.
- Jatkar, S. K. K. and B. N. Mattoo, Studies on Fluorescence of Organic Compounds, III, 26.
- Jatkar, S. K. K. and V. K. Phansalkar, Dielectric Constant and Dipole Moment of the Esters of Dicarboxylic Acids, III, 34.
- Jatkar, S. K. K. and V. K. Phansalkar, Dielectric Constant and Dipole Moment of the Esters of Monocarboxylic Acids (part II), III, 33.
- Javadekar, P. S., M. A. Shaikh and V. A. Patwardhan, Non-fatty Matter from the Seeds of (i) *Ocimum basilicum*, Linn., and (ii) *Ocimum canum*, Sims, III, 171.
- Javadekar, P. S., Diffusion and Activation control in Heterogeneous liquid-liquid system, III, 108.
- Jha, K. K., A. S. Varma, R. Singh and H. N. Mukherjee, Studies on Ammonification and Nitrification in Bihar soils in relation to soil conditions, III, 367.
- Jhaveri, Miss D. B. and V. M. Thakor, Friedel Crafts reaction on Peonol and Monomethyl ether of Methyl-B-resorcyate, III, 125.
- Jhingran, A. G., S. M. Mathur, S. N. Puri and R. S. Sharma, A Study of the Bundelkhand Granite in Chhatarpur District, Vindhya Pradesh, III, 195.
- Jogarao, A. and A. Sreenivas, Utilisation of South Arcot Lignite for the Production of Calcium Carbide, IV, 6.
- Jogdeo, S. M. and S. K. K. Jatkar, Studies of the Complex Metal Cyanides in Solution, III, 86.
- Johar, Dyal Singh, Bhagwan S. Lulla and V. Subrahmanyam, Development of Amylase under submerged cultivation of *Aspergillus Oryzae*, III, 144.
- Johar, Dyal Singh, Bhagwan S. Lulla and V. Subrahmanyam, Production of Fungal Diastase, III, 143.
- Johar, Dyal Singh, Bhagwan S. Lulla and V. Subrahmanyam, Production of Fungal Diastase, III, 143.
- John, (Miss) Rachel and S. N. Das-Gupta, Two species of Chytridium from Lucknow, III, 221.
- Joshi, R. D. and S. V. Chandrashekar Aiyar, Field strengths of fading signals in the Tropical Short Wave Broadcast Bands, III, 422.
- Joshi, N. V. and S. G. Joshi, A simple and cheap remedy to increase the low Fertility of Indian Soils, III, 361.
- Joshi, H. C. and B. Sen, Permeability of the Plasma Membrane of Leaf Cells of rust resistant and Susceptible Varieties of Wheat, III, 263.
- Joshi, R. V. and V. M. Dehai-Kulkarni, Characteristic features of the drainage around Dharwar (Bombay State), III, 212.
- Joshi, B. C., D. P. Mukherjee and P. Bhattacharya, Effect of Ovariectomy, Subcutaneous Grafting of Ovaries and Administration of Ovarian Hormone (Oestroform) on the Rate of Respiration, Body Temperature and Blood Morphology of Rabbits, III, 400.
- Joshi, R. V. and L. S. Bhat, Petrology and Morphology of the Deccan Trap flows around Kolhapur (Bombay State), III, 196.
- Joshi, R. V. and M. S. Honrao, Occurrence of Quartzite Bank near Karwar (Bombay State), III, 193.
- Joshi, C. G. and A. B. Kulkarni, Anthoxanthins : Part III. Synthesis of Flavan-3 : 4-diols, III, 138.
- Joshi, S. S. and S. A. Saletore, Fuller's earths from Hyderabad State, their occurrence and Bleaching Properties, III, 155.
- Joshi, C. G. and A. B. Kulkarni, Anthoxanthins : Part III. Synthesis of Flavan-3 : 4-idols, III, 138.
- Joshi, R. V., Study of the dispersion of some gaseous Organic Compounds, III, 35.
- Joshi, B. D., Near ultra violet Absorption spectrum of P-dichlorobenzene, III, 25.
- Joshi, R. V. and V. M. Dehai-Kulkarni, A note on the Geology of the Vernoli Hills near Dandeli (North Kanara Dist., Bombay State), III, 179.
- Joshi, R. B. and S. M. Sen, Study of a Non-Linear Magnetic Circuit, III, 425.

- Joshi- S. G. and N. V. Joshi, A simple and cheap remedy to increase the low Fertility of Indian Soils, III, 361.

K

- Kabi, T. and B. Samantarai, Cambial activation and secondary growth in the petioles of the rooted leaves, III, 266.
- Kabi, T. and B. Samantari, Effect of feeding on the rooting response of isolated leaves of *Ipomoea batatas*, III, 257.
- Kacker, I. K. and S. H. Zaheer, Reaction of Phenylmagnesium bromide with 3-Phenyl-4 (3H)-Quinazalone, III, 121.
- Kalankar, R. J., T. L. Deshpande and D. K. Ballal, Effect of growing cotton in rotation with the different crops on structure of black cotton soil, III, 363.
- Kalankar, R. J. and B. Deshpande, Investigations into the effect of green manuring of cotton and its residual effect on subsequent crop of grain juar, III, 358.
- Kalankar, R. J. and S. G. Kolte, Investigation into the effect of sowing Desli and American cottons successively and in rotation with each other with and without manuring, III, 359.
- Kalapesi, R. M. and B. L. Purohit, Rhinosporidiosis in Bovines in Bombay State, III, 349.
- Kalipady, Sripadrao and G. G. Deshpande, The Heavy Minerals of the Kamthi Sandstones, III, 186.
- Kalyanasundaram, S., Studies in the Germination of Seeds of the Leguminosae in relation to the evolutionary tendencies of its leaf, III, 227.
- Kamat, A. R., Distribution of the range in samples from a discrete rectangular population, III, 13.
- Kameswari, (Miss) S., V. S., Ramachandran and S. K. Bhattacharyya, Differential Thermal analysis of Catalyset powders: System: $\text{ThO}_2\text{Al}_2\text{O}_3$, III, 100.
- Kanekar, C. R., V. V. Deshpande and R. M. Mathur, Susceptibility of CH_4 and Hybridisation of Carbon, III, 93.
- Kanungo, M. S., Scorpion heart and its physiology, III, 288.
- Kappanna, A. N. and A. S. Dewagan, An Electrolytic Study of Aqueous Lead Formate Solutions, III, 88.
- Kapil, R. N., A contribution to the embryology of *Euphorbia esula* L. and *Chrozophora obliqua* A. Juss, III, 234.
- Kar, Amiya B., Responses of the adrenals of Thyroxine-treated rats to Adrenocorticotrophic hormone (ACTH), III, 398.
- Kar, B. K. and B. K. Desarkar, Dual purpose of Growing Jute for Fibre and Seeds, III, 356.
- Kar, Prithwish, Fabric of the Boileauganj Quartzites above the Jutogh Thrust within the Simla Klippe, III, 194.
- Kar, B. K. and S. K. Majumdar, Growth Sequence in Relation to Stalk and Foliage in the (*Corchorus*), III, 259.
- Kar, N. R., Geomorphic Features in the Sikkim hills and their Relation to the Pleistocene Ice-Age in the Eastern Himalaya, III, 212.
- Kar, Amiya B., The nature of influence of the thyroid on gonads, III, 398.
- Karrer, P. and A. K. Mitra, Reduction of tosyl esters with lithium aluminium hydride, III, 135.
- Kasliwal, R. M. and Ram Avatar Sharma, Significance of Sodium Clearance test in Cases of Ascites due to Cirrhosis of Liver, III, 339.
- Kaul, C. L. and P. N. Bhargava, Studies on 3-0 Toly-2-0-Tolylimino-4 Thiazolidone, III, 122.
- Kehar, N. D., K. Sahai and I. Kumar, Rape (*Brassica napus* Linn), Bhoosa as food for cattle, III, 365.
- by atmospheric temperature and by different doses of thyroxine, III, 399.
- Kelkar, K. V., On the Archaean rocks in the Southern Parts of Ra'nagiri District, and in Goa, III, 176.
- Keskar, V. R. and K. K. Dole, Thermal Polymerization of Dehydrated Castor Oil, III, 153.
- Khan, Amanullah, Om Prakash and T. R. Sharma, Preparation of Activated Carbons from the waste materials of the oil Industry viz. the Shell (Husks) of Neem, Castor and Mahua Seeds, III, 161.
- Khan, Amanullah, Om Prakash and T. R. Sharma, A Study of the Forest Oil seeds: *Albizzia labbek* and *Albizzia procera* and their Oils. Part I, III, 162.
- Khandekar, P. V. and J. N. Das, Study of the Current Voltage, Characteristics of n-p Contacts in Galena, III, 33.
- Kharkar, D. P., C. C. Patel and M. R. A. Rao, Carbides of Titanium, III, 82.

- Kharkar, D. P. and C. C. Patel, Peroxalates of Titanium, III, 83. &
 Khastgir, S. R. and C. M. Srivastava, The Streamer Mechanism and the Sparking
 "Threshold", III, 30.
- Khasgiwale, K. A. and S. K. K. Jatkar, The Potentiometric study of Double Salts,
 III, 107.
- Khasgiwale, K. A. and S. K. K. Jatkar, The Potentiometric Study of Metal Ammines,
 III, 85.
- Khosla, Baldev, Amperometric Estimation of Lead, III, 79.
- Khot, C. G. and S. V. Chandrashekhar Aiyar, Atmospheric Noise level in the 1
 Mc/s Band at Poona, III, 422.
- Kilpady, Sripadarao and A. S. Dave, On the Occurrence of Beryl in Madhya
 Pradesh, III, 183.
- Kalhatkar, G. B. and L. M. Apte, Catalytic decomposition of potassium chlorate
 in the presence of a mixture of catalysts and determination of the tem-
 perature coefficient of the decomposition, III, 95.
- Kolte, S. G. and R. J. Kalamkar, Investigation into the effect of sowing Deshi
 and American cottons successively and in rotation with each other with
 and without manuring, III, 359.
- Korgaonkar, K. S. and N. R. Tawde, Influence of Oxygen and Air on the Inten-
 sity Distribution among the Bands of N₂ second Positive System, III, 27.
- Korgaonkar, K. S., N. S. Ranadive and N. B. Sahasrabudhe, Chemical effects of
 ionizing radiations on solutions of Nucleic Acid, Purine and Pyrimidine bases
 by Spectroscopic Method, III, 147.
- Kulkarni, P. S. and K. K. Dole, Investigations in Viscosity of Milks. Part VII—
 Viscosity of Milk and Adulteration (by added water), III, 81.
- Kulkarni, A. B. and C. G. Joshi, Anthoxanthins : Part III. Synthesis of Flavins-3 :
 4-diols, III, 138.
- Kulkarni, A. B. and C. G. Joshi, Anthoxanthins : Part III. Synthesis of Flavins-3 :
 4-diols, III, 138.
- Kulkarni, L. Y., Syllabus of Local Geography in Secondary Schools, IV, 8.
- Kulkarni, M. P., T. N. Mehta and B. Y. Rao, Solvent Segregation of Linseed
 Oil and Safflower Oil by Ethyl Alcohol, III, 148.
- Kulkarni, S. N. and N. L. Tikotkar, Substituted Quinoline Acetic Acids, III, 114.
- Kundo, A., On the Testing of outlying Observation, IV, 2.
- Kundu, A. K., B. C. Kundu, M. K. Mukherjee and G. Halder, Retting of Jute : III :
 Shortening of Retting Period by Means of Chemical Activators, III, 377.
- Kundu, A. K., B. C. Kundu, M. K. Mukherjee and G. Halder, Retting of Jute : III :
 Shortening of Retting Period by Means of Chemical Activators, III, 377.
- Kundu, A. K. and G. Halder, A note on the Biochemical changes during retting
 of jute, III, 369.
- Kundu, B. C. Mukherjee and G. Halder, A Short Note on the Growth of Jute (*C.*
Capsularis—D 154) with Fertilisers under Water-logged conditions, III, 354.
- Kundu, A. K., M. K. Mukherjee, S. C. Chakravorty and G. Halder, Jute leaves
 as manures : I : Influence on the growth of paddy, III, 360.
- Kundu, B. C., A. N. Datta and P. Sanyal, Comparative Study on the Yield Per-
 formances on the Different Fibre Crops, III, 355.
- Kundu, B. C., A. N. Datta and P. Sanyal, Preliminary Studies on the Effect of
 Different Dates of Sowing in Mesta and Roselle, III, 258.
- Kundu, B. C. and N. S. Rao, Origin and Development of Axillary Buds in *Hibiscus*
cannabinus, III, 229.
- Kundu, P., An Accurate System of Measuring an Interval of Time, III, 426.
- Krishna, Daya and Ishwar Prakash, Ecological Studies of mammals of Rajasthan
 desert, Gerbilles, III, 311.
- Krishnan, T. S., V. Seetharama Rao and T. D. Mahadevan, The Influence of Cap-
 onisation on the Carcass Composition, Edible Meat content and Palatability
 of Chicken of the Same Age and Breed, III, 346.
- Krishna, Daya and Ishwar Prakash, Ecological studies of the mammals of Rajasthan
 than desert. Hedgehogs : Fossorial habits, III, 310.
- Krishna, Daya and Ishwar Prakash, Ecological studies of the Mammals of Rajasthan
 desert : Distribution, III, 310.
- Krishna, Daya and Ishwar Prakash, Ecological Studies of the mammals of Rajas-
 than desert. Hedgehogs : Rolling, III, 311.
- Krishna, Daya and Ishwar Prakash, Ecological studies of the mammals of Rajas-
 than desert. Hedgehogs : Feeding habits, III, 311.
- Krishnamorthy, K. and S. Mukerji, Studies on the Genus *Plusia* with special
 Reference to Male Genitalia (Noctuidae : Lepidoptera), III, 295.
- Krishnaswami, K. R., S. Satyanarayana and T. L. Rama Char, Electrodeposition
 of Nickel and Zinc from the Sulphamate bath, III, 173.

- Krishnaswami, K. R. and V. A. Krishna Murthy, Reaction between butyl alcohol and ammonia under pressure, III, 112.
- Krishnaswami, K. R. and V. Ramakrishna, Hydrogenation of Ethylene at OoC on a cobalt catalyst, III, 112.
- Krishnaswami, K. R. and Sundarajan, The Dipole moment and molecular structure of quinone oximes, III, 98.
- Krishnaswami, V. D., "The Antiquity of the Karnatak Rock Engravings", IV, 14.
- Kumar, Mrs. Myra, Rorschach Pattern of a Group of Nirmal Adults, III, 407.
- Kumar, I., K. Sahai and N. D. Khar, Rape (*Brassica napus* Linn). bhossa as food for cattle, III, 365.
- Kumari, Sulazana, On the Determination of the Jump of a Function by its Fourier Series, III, 5.

L

- Lad, V. S. and D. K. Patel, Effect of continuous growing of the same crop and rotational system of cropping on soil fertility, III, 363.
- Laha, R. G., On a characterisation of the stable law with finite expectation, III, 16.
- Lahiri, D., Mineral matters in Coal and a Technique for their removal, III, 204.
- Lahiri, D., A Preliminary study of Microfossils in Coal Seam No. X, North Damuda Colliery, Jharia Coal Field, III, 182.
- Lahiri, A. K., K. C. Som and G. P. Chatterjee, Vibration Damping Characteristics of some Typical Metals and Alloys, III, 431.
- Lakshmana, B. R. and C. C. Patel, Spectrophotometric studies on thorium and uranium complexes of morellin, III, 99.
- Lakshminarayan, L. and J. Venkateswarlu, Contribution to the embryology of *Hydrocera Triflora* W. & A., III, 236.
- Lakshminarayana, V. and B. Ramachandra Rao, Ultrasonic Velocities in solutions of Iodine in Aqueous Solutions of Potassium Iodide, III, 35.
- Lal, M. B. and S. C. Srivastava, Reaction of Arachnid cuticle to some Chemical Reagents, III, 288.
- Lal, M. B. and S. C. Srivastava, On some peculiarities of the Cuticle of Indian Myriapods, III, 286.
- Lal, D. N., A note on the distribution of the product of ranges in samples from rectangular population, III, 13.
- Lal, D. N., A note on a form of the Weak Law of Large Numbers associated with several variables, III, 14.
- Lal, D. N. and J. Dutta, A system of orthogonal polynomials, III, 15.
- Lal, A. B., S. C. Mondal, S. K. Das and H. N. Mukherjee, Studies on the nitrogen economy and aggregation of an upland soil of South Bihar, III, 368.
- Lal, Girdhari and J. S. Pruthi, Studies on the nutritive value and utilisation of purple passion fruits (*Passiflora edulis* Sims), IV, 16.
- Lal, Girdhari and J. S. Pruthi, Germination trials on passion needs (*Passiflora edulis*), IV, 17.
- Lal, Girdhari and J. S. Pruthi, Refrigerated storage of purple passion fruits (*Passiflora edulis* Sims), IV, 16.
- Lal, S. B., Consumption in Yet Another Food Scarcity Areas of Bihar, III, 340.
- Lal, S. B. and S. P. Roy Chowdhury, Total and "Available iron" in some foods, III, 340.
- Lele, S. S., N. H. Shah and Suresh Sethna, Studies in Hydroxyanthracene derivatives. Part I, reactions of 1-anthrol, III, 115.
- Limaye, S. D. and H. K. Pendse, Synthesis of 2-4'-dimethyl-8'-acetyl-6'-7'-furocoumarin, III, 115.
- Lote, S. J. and R. V. Tamhane, Soils Hills, III, 366.
- Lutuke, S. N., K. Pal, S. K. De and Bhattacharyya, Studies on ascorbic acid content in the semen of hill bulls and zuffalo bulls and its correlation with the seminal fructose and semen equality, III, 400.
- Lulla, Bhagwan S., Dyal Singh Johar and V. Subrahmanyan, Production of Fungal Diastase, III, 143.
- Lulla, Bhagwan S., Dyal Singh Johar and V. Subrahmanyan, Development of Amylase under submerged cultivation of *Aspergillus Oryzae*, III, 144.
- Lulla, Bhagwan S., Dyal Singh Johar and V. Subrahmanyan, Production of Fungal Diastase, III, 143.

M

- Madan, M. P., Intermolecular Force constants for an Exponential Potential Energy Function, III, 36.
- Magar, N. G. and P. P. Nair, Estimation of Total Tocopherols in Blood, III, 82.

- Magar, N. G. and P. P. Nair, Molybdenum content of some Indian Pulses, III, 145.
- Magar, N. G. and R. K. Sharma, Study of the visceral fat of Kan Mushi, III, 145.
- Mahadevan, T. D., T. S. Krishnan and V. Seetharama Rao, The Influence of Caponisation on the Carcass Composition, Edible Meat content and Palatability of Chicken of the Same Age and Breed, III, 346.
- Mahadevan, T. M., A Note on the Geology and Petrology of some Newer Dolerite and Olivine Gabbro near Haludpukhur, Singhbhum District, Bihar, III, 201.
- Mahapatra, G. N. and M. K. Rout, Preparation of Thiazolidones and their 5-p-sulphonamido-phenylazo derivatives, III, 123.
- Mahapatra, G. N. and M. K. Rout, Some derivatives of 2-arylimino-4-thiazolidones, III, 124.
- Maheshwari, P. and Manasi Ghosh, The Systematic Position of *Exocarpus*, III, 234.
- Maheshwari, J. K., Contribution to the Embryology of *Duranta Plumieri* Jacq., III, 240.
- Maheshwari, P., R. C. Sachar and R. N. Chopra, Embryological Studies in Mango (*Mangifera Indica* L.), III, 233.
- Majid, S. A., The Tasar Silk, IV, 7.
- Maiti, Ajit, B. B. Sarkar and Bhupendra Nath Chaudhuri, Effect of Kukscine—the active principle of *Vernonia cinerea* (less) on the clotting activity of blood, III, 393.
- Maiti, Ajit, B. B. Sarkar and Hrishikesh Jana, Effect of Kukscine on the Haematological studies of rabbits, III, 396.
- Maiti, Ajit and B. B. Sarkar, The Action of Kukscine—the active principle isolated from *Vernonia cinerea* (Less) on the Plain Muscles, III, 395.
- Maiti, Ajit and B. B. Sarkar, Studies on the action of Kukscine—the active principle isolated from the *Vernonia cinerea* (less) on the Tracheal chain and Lung perfusion, III, 392.
- Maitra, S. R., R. Ghosh and N. K. Sarkar, Existence of a Cardio-stimulating Factor in Cobra Venom, III, 391.
- Majumdar, D. K. and P. C. Rakshit, The Phase diagram study of some Binary system, III, 92.
- Majumdar, Anil Kumar and Siddheshwar Banerjee, Estimation of Silica, III, 78.
- Majumdar, S. K., M. Muthu and S. V. Pingale, A Bacterial Disease of *Heliothi obsoleta* F., a Pest of Vegetable and Fruit Crops, III, 379.
- Majumdar, S. K., M. Muthu and S. V. Pingale, A Bacterial Disease of *Heliothi obsoleta* F., a Pest of Vegetable and Fruit Crops, III, 379.
- Majumdar, S. K. and Nirad K. Sen, Enrichment of Soil Plate for the Isolation of Specific Organisma, III, 219.
- Majumdar, S. K. and B. Kar, Growth Sequence in Relation to Stalk and Foliage in the (*Corchorus*), III, 259.
- Majumdar, B. R. and P. N. Bhaduri, Pollen grain Smear Method for Cereals, III, 253.
- Majumdar, K. K. Studies in Flaky Graphite—Part II, III, 150.
- Majumdar, K. K. Studies in Flaky Graphite—Part I, III, 150.
- Majumdar, K. K. Utilisation of Waste Mica, Part II, III, 428.
- Majumdar, S. K., Microphilological Commensalism in the decomposition of Alpha-Humus, III, 369.
- Malhotra, C. L., Coronary Vasodilators and Blood Coagulability, III, 392.
- Malhotra, C. P., Binomics of *Serinthia augur* Fabh. and its association with *Dysdercus cingulatus*, the red cotton bug, IV, 15.
- Mandal, S. C., S. K. Das, A. B. Lal and H. N. Mukherjee, Studies on the nitrogen economy and aggregation of an upland soil of South Bihar, III, 368.
- Mandal, S. C., H. N. Mukherjee and B. D. Mukherjee, Potash needs of Bihar soils, III, 365.
- Mandal, S. C., A. S. Varma and H. N. Mukherjee, Mineral of plants and its relation to the synthesis of ascorbic acid, III, 377.
- Mandal, S. C., M. A. Ali and H. N. Mukherjee, Boron requirements of some Bihar Soils, III, 362.
- Mandal, S. C., H. N. Mukherjee and B. S. Banerjee, Increasing the fertiliser phosphate availability to plants and testing chemical methods for available phosphate determination, III, 259.
- Mandan, Sahib Ram, Moebius Tetrads, III, 6.
- Marathe, M. G., Synthesis of Dihydro Flavonols and Flavonols—Part III: Synthesis of Naphtha Dihydroflavonol, III, 117.
- Marathey, M. G., J. M. Athavale and K. G. Gore, Synthesis of Dihydro Flavonol and Flavonols. Part V: Synthesis of 5:6-substituted flavonols, III, 119.
- Marathey, M. G. and K. G. Gore, Synthesis of 4-methyl-6-ethyl-2'-phenyl coumarin-7:8-y-pyrone, III, 118.
- Marathey, M. G. and K. G. Gore, Synthesis of Dihydroflavonols and Flavonols. Part IV: Synthesis of bromoflavonols, III, 118.

- Mattoo, B. N. and S. K. K. Jatkar, Absorption Spectra of Coumarins, III, 108.
- Marwani, C. S. and P. P. Singh, Interaction of Histidine with Sugars in aqueous solutions studied potentiometrically. Part I: Glucose, III, 101.
- Mattoo, B. N. and S. K. K. Jatkar, Studies on Karanja Oil: Spectrophotometric Investigation of the Unsaponifiable Matter, III, 168.
- Mathew, N. T., Statistics of library utilization, III, 22.
- Mathew, A. P., Observations on the Post Embryonic Development of *Machraerota* Sp., III, 300.
- Mathur, P. B. and H. C. Srivastava, Studies in the Cold Storage of Langsats, III, 378.
- Mathur, S. S. and S. P. Pathak, The Component Acids and Glycerides of Arecanut (*Areca catechu*) fat, III, 160.
- Mathur, S. M. and Kedar Narain, On the ungel Series, III, 173.
- Mathur, S. M., Geology of the Panna Diamond Deposits, III, 176.
- Mathur, R. M., C. R. Konekar and V. V. Deshpande, Susceptibility of CH_2 and Hybridisation of Carbon, III, 93.
- Mathur, S. M., The Stratigraphical Position and Classification of the Transition Series in the Son Valley, III, 181.
- Mathur, P. B. and H. C. Srivastava, Studies in the Cold Storage of Langsats, III, 378.
- Mathur, P. B. and H. C. Srivastava, Effect of Terpineol in inhibiting the Sprouting of Potato Tubers during Storage, III, 375.
- Mathur, P. B. and K. Kirpal Singh, Cold Storage of Grapes, III, 374.
- Mathur, B. B. L. and N. P. Benawri, Amylolytic enzymes in the saliva of new born infants, III, 387.
- Mathur, B. B. L. and N. P. Benawri, Comparison of the amylolytic activity of the Saliva of new born infants and adult human subjects, III, 387.
- Mathur, P. B., K. Kirpal Singh and H. C. Srivastava, Studies on the Cold Storage of Mangosteen (*Garcinia mangostana*), III, 378.
- Mathur, S. M., A. G. Jhingran, S. N. Puri and R. S. Sharma, A Study of the Bundelkhand Granite in Chhatarpur District, Vindhya Pradesh, III, 195.
- Mathur, P. B. and H. C. Srivastava, Cold Storage of Field Beans (*Dolichos lablab*), III, 374.
- Mechanism of Gastrulation, IV, 93.
- Mehra, K. N., Studies on the life history of *Hymenolepis fraterna* (Stiles, 1905), a tapeworm of rat, III, 284.
- Mehra, K. N., Studies on the life history of *Hymenolepis diminuta* (Rud, 1819), common tapeworm of rat and man, III, 284.
- Mehra, K. N. and S. C. Dutt, Studies on the life history of *Hymenolepis farcinosa* (Goeze, 1782), a tapeworm of crow and collared myna, III, 283.
- Mehra, K. N. and H. D. Srivastava, Studies on the life history of *Moniezia expansa* (Rud., 1810), a broad tapeworm of ruminants, III, 352.
- Mehra, K. N. and H. D. Srivastava, Studies on the life history of *Ascaris vitulorum* (Goeze, 1782), the large intestinal roundworm of bovines, III, 354.
- Mehra, K. N. and H. D. Srivastava, Studies on the life history of *Moniezia benedeni* (Moniez, 1879), a tapeworm of ruminants, III, 352.
- Mehrotra, R. C., Mixed Teritary Alkoxides of Zirconium, III, 107.
- Mehrotra, R. C. and N. N. Sharma, Oxidation of Citric Acid by Ceric Sulphate, III, 106.
- Mehrotra, R. C. and N. N. Sharma, Oxidation of Phenolic compounds with Ceric Sulphate, III, 107.
- Mehrotra, R. C., Soaps of Titanium, III, 107.
- Mehrotra, R. C. and N. N. Sharma, Oxidation of Glycerol with Ceric Sulphate, III, 106.
- Mehrotra, P. N. and D. N. Mullick, Seasonal variations in the Physiological reactions in normal sheep, III, 403.
- Melita, G. K. and N. R. Tawde, Estimation of Electron Energy in H. F. Discharge in H_2 . Part I—Probe Method, III, 29.
- Melita, G. K. and N. R. Tawde, Estimation of Electron Energy in H. F. Discharge in H_2 . Part II—Spectroscopic Method, III, 29.
- Melita, B. V. and C. C. Shah, Effect of Different Levels of Plant Potassium on the Uptake of Cations by Bajri (*Pennisetum typhoideum*), III, 374.
- Melita, T. N., B. Y. Rao and M. P. Kulkarni, Solvent Segregation of Linseed Oil and Safflower Oil by Ethyl Alcohol, III, 148.
- Mehta, B. H., Rehabilitation of Ex-criminal Groups, IV, 13.
- Melita, B. V. and C. C. Shah, Accumulation and Movement of Minerals in Bajri (*Pennisetum typhoideum*), III, 373.
- Meenakshi Miss V. R., How Pila without protease meets in protein requirements, III, 279.

- Mene, P. S., P. N. Vishen, V. R. Sohoni and Y. G. Sathe, Battery grade MnO_2 from M.P. manganese ore by Chemical treatment, III, 173.
- Menon, P. G. and D. Singh, Potentiometric Estimation of Sulphide, III, 103.
- Menon, P. G. and D. Singh, Variation of the Sulphide Concentration of Aqueous Hydrogen Sulphide Solutions with Time, III, 103.
- Menon, P. G. and D. Singh, Conductometric Estimation of Thorium and Cerium, III, 103.
- Menon, P. Balarama, A preliminary report on the incidence of Surra and Tabanus flies in Rajasthan, III, 350.
- Menon, P. Balarama, *Centrodora* sp. (Hymenoptera: Encyrtidae) parasitising eggs of Tabanidae in Rajasthan, III, 293.
- Menon, P. K. B., Anatomy of the digestive system of *Poecillocerus pictus* (Fabr.), III, 299.
- Menon, P. Balarama, Some observations on the biology of *Hippobosca* species with special reference to the pupal period, III, 293.
- Menon, P. Balarama, Studies on the seasonal incidence of insects and other arthropods of livestock, III, 293.
- Mewada, G. S. and N. M. Shah, Nitration of 6-hydroxy-4-methyl coumarin and its methyl ether, III, 127.
- Mewada, G. S., S. R. Patel and N. M. Shah, Synthesis of 2:8-dimethyl-3-substituted-4-quinazolones, III, 126.
- Minerals in Soils and Clays, IV, 101.
- Mirashi, M. V., Contribution to our Knowledge of the Physiological Anatomy of Some Indian Hydrophytes.—II. The Stem of *Eclipta alba* Hassk, III, 242.
- Mishra, D., Effect of adrenal cortex on digestibility of a few fats in albino rats, III, 144.
- Mishra, A. K., A. Das Gupta and M. Purakayastha, Survey of antibiotic-producing actinomycetes from Indian Soils, IV, III, 220.
- Mishra, S. D., Mathura—a Socio-Geographic Study, IV, 9.
- Misra, (Miss) Rani and B. P. Gyani, The Reaction between Chloride and Ammonium Thiocyanate—Part II, 90.
- Misra, (Miss) Rani and B. P. Gyani, Some Salts of Iron with Organic Acids, III, 91.
- Misra, (Miss) Rani and B. P. Gyani, The behaviour of Ferric Chloride in Organic Solvents, III, 90.
- Misra, G. and B. Samantarai, Effect of spraying B-indolyl acetic acid solution on the growth and reproduction of rice plants, III, 266.
- Misra, Gadadhar, Effect of long daylength on three medium-early varieties of Rice, III, 265.
- Misra, Gadadhar, Effect of Long Photoperiod on Four Late-winter Varieties of Rice, III, 265.
- Misra, Gadadhar, Effect of Long-day Photoperiod on Four Early Winter Varieties of Rice, III, 265.
- Misra, G. and B. Samantarai, Effect of various levels of Nitrogen on the vegetative growth and ear emergence of rice plants, III, 257.
- Misra, R. C. and M. N. Saxena, Variation in Boudelkhand Gneiss, III, 196.
- Mitra, R. B. and B. D. Tilak, Synthesis of a Thiophene Analogue of 3-Desoxy-equilenin, III, 121.
- Mitra, D. N., On stress concentration of an isotropic elastic disc of some boundaries rotating steadily in its place, III, 9.
- Mitra, Subodh, Seasonal Effect on the Incidence of Eclampsia, III, 329.
- Mitra, Subodh, Evaluation of 5-year End-results in Cancer of the Cervix treated by radiation and operation, III, 329.
- Mitra, R. D., Sandflies of Northern Regions of the Western Ghats, III, 335.
- Mitra, R. D., The Relationship of Insects of the Genus *Phlebotomus* to Disease, III, 336.
- Mitra, Subodh, A new Approach to the Extended Radical Vaginal Hysterectomy and Extraperitoneal Pelvic Lymph-Adenectomy for Cancer of the Cervix, III, 329.
- Mitra, Subodh and S. K. Basu, The assessment of the type and size of Indian Female Pelvis, III, 327.
- Mitra, Subodh, Radiation Therapy in Cancer of the Cervix—A New Technique, III, 328.
- Mitra, A. K. and P. Karrer, Reduction of tosyl esters with lithium aluminium hydride, III, 135.
- Modak, H. V., A Method of Testing Musical Tuning and Intonation with "Automatic Musical Instrument", III, 39.
- Modern Trends in Analytical Chemistry, IV, 51.
- Moghe, M. A., Peculiar Amniogenesis in *Cynopterus sphinx geneticus* (Anderson), III, 279.
- Moghe, Sindhu, On the Morphogenesis of the Yolk-sac Gland in Chiroptera, III, 279.

- Mohajir, (Miss) Aktar and D. S. Datar, Decomposition of Tricalcium Phosphate in presence of Sodium Carbonate and Alumina, III, 151.
- Mohajir, (Miss) Akhtar and D. S. Datar, Monocalcium Tetra Sodium Phosphate—Part II, III, 154.
- Mohajir, Miss Akhtar and D. S. Datar, Mono Calcium tetra sodium phosphate—Part I, III, 155.
- Mohapatra, G. N., Nabinkishore Das and M. K. Rout, Thiazole Derivatives and their Fungicidal action. Part 1—2-substituted-amino 4-5-dimethyl thiazoles, III, 113.
- Mohapatra, S. and R. Mohanty, On the Absolute Logarithmic Summability of Fourier series and its Differentiated series, III, 2.
- Mohanty, R. and M. Nanda, On the Logarithmic mean of the Derived Conjugate series of a Fourier Series, III, 2.
- Mohsin, S. M., Assessing General Intelligence of Children from a Short Interview, III, 406.
- Mohanty, R. and S. Mohapatra, On the Absolute Logarithmic Summability of Fourier series and its Differentiated series, III, 2.
- Mohsin, S. M., Defence Against Ego-threat in Self-judgment—A Factorial Study, III, 407.
- Moitra, S. K. and S. M. Das, On the correlation between fish-food and fish-gut in food fishes of U.P., IV, 10.
- Moitra, S. K. and S. M. Das, On fish mortality in tanks and ponds of U.P., IV, 11.
- Molecular Spectra and Molecular Structure, IV, 44.
- Mookherjee, Sivatosh and Bansidhar Hajra, Cytic Viability of Soil Amoebae, III, 281.
- Mookherjee, P. B., Preliminary trials on the efficacy of some of the recently discovered organic insecticides and some plant poisons against the red-hairy caterpillar, *Amsacta moorei* Butler, III, 381.
- Mookherjee, P. B., Preliminary trials on the efficacy of some of the recently discovered organic insecticides and some plant poisons against the red-hairy caterpillar, *Amsacta moorei* Butler, III, 381.
- Mookherjee, H. K., D. N. Ganguly and B. D. Hajra, On the functional morphology of the organs concerned with intake of food of some teleostean fishes in relation to their feeding habit : Topography of the facial portion and gross anatomy and histology of lips and barbels, III, 303.
- Mookherjee, H. K., D. N. Ganguly and S. K. Das, On the structure and development of the Weberian apparatus in a Silurid fish, *Silundia gangetica*, III, 303.
- Mookherjee, H. K., D. N. Ganguly and T. P. Chatterjee, On the development of the notochord and the vertebral column in the Cyprinodont, *Orizias melastigma* (McClelland), III, 278.
- Mookherjee, Sivatosh, Cytochemistry of Evocator Complex, III, 273.
- Mookherjee, Sivatosh and Bansidhar Hajra, Compositional changes during Phase variation of Amoebae, III, 273.
- Mookherjee, Sivatosh and Asoke Bose, Ionising Interference on the Levels of Organiser Action, III, 273.
- Mookherjee, Sailen and D. P. Sadhu, A method of the determination of free Total Cholesterol in blood and tissues, III, 403.
- Moorthy, K. N. and D. S. Datar, Action of steam on Chitaldrug (Mysore) Pyrites, III, 151.
- Moza, B. K. and S. K. Ganguly, An investigation on the Glycosides of *Digitalis lanata* Ehrh. grown in Kashmir. Part I, III, 134.
- Mukherjee, H. N., S. C. Mandal and B. S. Banerjee, Increasing the fertiliser phosphate availability to plants and testing chemical methods for available phosphate determination, III, 259.
- Mukherjee, Ajitkumar, Colorimetric Determination of Iron with p-Amino-Salicylic Acid (Sodium Salt), III, 41.
- Mukherjee, Ajit Kumar, Inner-Metallic Complex Salts of o-Hydroxyaldimino Acids with Polycyclic Rings, III, 120.
- Mukherjee, A. K., Salinity in Rain Water, IV, 6.
- Mukherjee, S. N., Inophoresis of Purines and Pyrimidines from Yeast Nucleic Acid, III, 111.
- Mukherjee, Bankim, Microscopical study of Ilmenite and other opaque minerals and the associated rocks from Bhaluwari, Gaya district, III, 184.
- Mukherjee, Bankim and Saurin Sen, Note on the occurrence of Magnetite bearing Quartzites near Ramchandrapur, E. Manbhum, III, 187.
- Mukherjee, J. N., N. N. Das, P. B. Sen and M. N. Razdan, A Hypnotic Action of Rauwolscine, III, 396.
- Mukherjee, K. L. and G. Werner, Biological effect of Macromolecular substances, III, 394.
- Mukherjee, J. N., P. B. Sen and N. N. Das, Effect of Rauwolscine on the central nervous system, III, 395.

- Mukherjee, D. P., B. C. Joshi and P. Bhattacharya, Effect of Ovariectomy, Subcutaneous Grafting of Ovaries and Administration of Ovarian Hormone (Oestroform) on the Rate of Respiration, Body Temperature and Blood Morphology of Rabbits, III, 400.
- Mukherjee, M. K., B. C. Kundu, A. K. Kundu and G. Halder, Retting of Jute : III : Shortening of Retting Period by Means of Chemical Activators, III, 377.
- Mukherjee, Sunil Kumar and P. S. Verma, Studies on the varietal classification and virus resistance in lady's finger (*Abelmoschus Esulentus* Linn), III, 371.
- Mukherjee, J. N. and P. B. Sen, Effect of Rauwolscine Hydrochloride on the Voluntary Muscles, III, 389.
- Mukherjee, Sunil Kumar and K. Roy Choudhury, Floral Biology in Mango, III, 370.
- Mukherjee, H. N., S. C. Mandal and B. D. Mukherjee, Potash needs of Bihar soils, III, 365.
- Mukherjee, H. N., S. C. Mandal and M. A. Ali, Boron requirements of some Bihar Soils, III, 362.
- Mukherjee, M. K., S. C. Chakravorty, A. K. Kundu and G. Halder, Jute leaves as manures : I : Influence on the growth of paddy, III, 360.
- Mukherjee, M. K. and S. C. Chakravorty, Exhibition of the Soil and Uptake of Nutrients by Different Varieties of Jute Grown under the same conditions, III, 376.
- Mukherjee, H. N., S. C. Mandal and A. S. Verma, Mineral of plants and its relation to the synthesis of ascorbic acid, III, 377.
- Mukherjee, M. K., B. C. Kundu and G. Halder, A Short Note on the Growth of Jute (*C. Capsularis*—D 154) with Fertilisers under Water-logged conditions, III, 354.
- Mukherjee, J. N. and P. B. Sen, Comparative Studies of Rauwolscine with Yohimbine on the Blood Pressure and Respiration, III, 396.
- Mukherjee, J. K. and G. P. Chatterjee, Changes in Thermoelectro-motive Forces on Low Temperature Tempering of Quenched Steel Samples, III, 428.
- Mukherjee, J. N., P. B. Sen and Amal Kumar Biswas, Effect of Rauwolscine on the Cholesterol and Ascorbic Acid Content of Adrenal Gland, III, 396.
- Mukherjee, J. N. and P. B. Sen, Determination of Toxicity and Therapeutic dose of Rauwolscine, III, 394.
- Mukherjee, J. N., P. B. Sen and Amal Kumar Biswas, A new Anti-histaminic Substance, III, 394.
- Mukherjee, B. D., H. N. Mukherjee and S. C. Mandal, Potash needs of Bihar Soils, III, 394.
- Mukherjee, H. N., S. C. Mandal, S. K. Das and A. B. Lal, Studies on the nitrogen economy and aggregation of an upland soil of South Bihar, III, 368.
- Mukherjee, B. N., S. K. Basu, S. K. Ray and Amitava Basu, A study of the weights of some viscera from 2000 necropsies in Calcutta, III, 327.
- Mukherjee, H. N., K. K. Jha, A. S. Varma and R. Singh, Studies on Ammonification and Nitrification in Bihar soils in relation to Soil conditions, III, 367.
- Mukherjee, Bhabananda, Family structure and Laws of Residence, Succession and Inheritance among the Urali of Travancore, III, 324.
- Mukherjee, Bhabananda, Social Groupings among the Khasi of Assam, III, 323.
- Mukherjee, Sunil Kumar, Origin and Distribution of *Saccharum* Linn, III, 236.
- Mukherjee, K. N., Some Aspects of Historical Geography in Bengal, III, 215.
- Mukherjee, S. K. and P. N. Nandi, Antibiotic activities of some fungi from the Soil West Bengal, III, 220.
- Mukherjee, Bankim and Supriya Roy, Ore-microscopic study of the Lead-Zinc-Silver ores of Zawar Mines, Rajasthan, III, 205.
- Mukherjee, Amal Bhusan and P. Sen, Preliminary note on the life history of *Amsacta lactineus* (Gram), a pest of groundnut (*Arachis hypogea*), III, 291.
- Mukherjee, Pratip Kumar, Textural Evolution in the Rajmahal Basalts, in the vicinity of Simra, Santhal Parganas, Bihar, III, 189.
- Mukherjee, J. N. and P. B. Sen, Site of Hypotensive Action of Rauwolscine Hydrochloride, III, 393.
- Mukerji, D. and Barundeb Banerjee, Anatomy of the termite, *Odontotermes rede-manni* (Wasmann), III, 289.
- Mukerji, D. and S. K. Das Gupta, A comparative study of the mouth-parts of ants, III, 290.
- Mukerji, D. and M. N. Dey, Morphology and anatomy of the cigarette beetle, *Iasioderma serricorne* (Fab.) III, 290.
- Mukherji, Nirod, Problems of standard with special reference to examination, III, 410.
- Mukherji, B. K., Dipti Kalyan Chowdhury and M. M. Chakrabarty, Studies on some Seed Fats of Cucurbitaceae Family—Part X. Component Fatty Acids from the Seed Fat of *Aussa Aegyptiaca* (Beng.-Dhundhul), III, 158.

- Mukherji, B. K., Dipti Kalyan Chowdhury and M. M. Chakrabarty, Studies on some Seed Fats of Cucurbitaceae Family—Part IX. Component Fatty Acids of the Seed Fat *Luffa Acutangula*, (Beng-Jhinga), III, 157.
- Mukherji, B. K., Dipti Kalyan Chowdhury and M. M. Chakrabarty, Studies of some seed fats of Cucurbitaceae family—Part VIII. The component fatty acids of *Tricosanthes Anguina*, III, 157.
- Mukerji, D. and K. Sen, Cephalic morphology, mouth parts and the anatomy of Silver fish, *Ctenolepisma longicaudata* Pisch (Thysanura), III, 290.
- Mukherji, S. and A. K. Sharma, The Male Genitalia of the Desert Locust *Schistocerca* (Forsk.) (Acrididae : Orthoptera), III, 205.
- Mukherji, Ramen and A. K. Sharma, Effect of Irradiation on Embryonic Cells, III, 250.
- Mukherji, Krishna and S. N. Chattopadhyay, The Potato wilt caused by *Pseudomonas Solanacearum* Var. *Asiatica* (E. F. Smith) Stapp. in West Bengal, III, 217.
- Mukherji, Krishna and S. B. Chattopadhyay, Pigment formation of *Serratia Marcescens* Bizio—reported from India for the first time, III, 218.
- Mukherji, B. K. and Arun Kanti Dutta, Studies on Sulphonation of Modified Oils, III, 150.
- Mukherji, B. K. and Dipti Kalyan Chowdhury, Studies on Dehydration of Castor Oil. Part I, III, 140.
- Mukerji, S. and K. Krishnamorthy, Studies on the Genus *Plusia* with special Reference to Male Genitalia (Noctuidae : Lepidoptera), III, 295.
- Mukherji, B. K., Dipti Kalyan Chowdhury and M. M. Chakravarty, Studies on some Seed Fats of Cucurbitaceae Family—Part VI. Component Fatty Acids of the Seed Fat from *Momordica Charantia* Linn. Variety—*Muricata* (Bengali-Ucche), III, 156.
- Mukherji, B. K., Dipti Kalyan Chowdhury and M. M. Chakravarty, Studies on some Seed Fats of Cucurbitaceae Family—Part VII. Component Fatty Acids of the Seed Fat from *Momordica Charantia* Linn. Variety—'Proper' (Beng.-Karala), III, 156.
- Mukherji, B. K., D. K. Chowdhury and M. M. Chakrabarty, Studies of some seed fats of Cucurbitaceae family—Part V, III, 155.
- Mulay, B. N. and B. S. Shami, Megasporangium, Megasporogenesis and Female Gametophyte of *Mimosa Rubicaulis*, Lamb, III, 241.
- Mulay, B. N. and D. S. Dhami, Microsporangium, Microsporogenesis and Male Gametophyte of *Mimosa Rubicaulis*, Lamb, III, 227.
- Mullick, D. N. and P. N. Mehrotra, Seasonal variations in the Physiological reactions in normal sheep, III, 403.
- Mullick, D. N. and N. D. Kehar, Testicular activity of the rats as influenced by atmospheric temperature and by different doses of thyroxine, III, 399.
- Murari, M., B. P. Gyani and A. C. Roy, Oil Tannin from *Caesalpinia Digyna* (Teri), III, 260.
- Murari, Madan and B. P. Gyani, Viscosity and Critical Solution Temperature of some Oil Mixtures, III, 148.
- Murthi, M. V. N., The Origin of Coronas around Olivine, III, 189.
- Murty, Y. G. K. and P. C. Hazra, A Note on the occurrence of Elliposoidal Lava near Kantapali, Sundargarh district, Orissa, III, 185.
- Murty, T. V. V. G. R. K., Occurrence of a Tertiary Limestone in Mewar State, III, 181.
- Murty, V. V. Suryanavayana, M. S. Powar and Narahari, Patterns of flowering in the improved rice varieties of Hyderabad, III, 360.
- Murty, T. V. S. and S. S. Banerjee, Resistance of Electrical Wires at Ultra-high Frequencies and its Effect on the Measurement of Wavelength by Lecher Wires, III, 423.
- Murthy, M. V. N., Sillimanite-kyanite association near Jamori, Sidhi District, Vindhya Pradesh, III, 187.
- Murthy, V. S. R., Preliminary Observations on the Hydrography and Inshore Plankton in the Bay of Bengal off Kakinada Coast, III, 316.
- Murthy, V. A. Krishna and K. R. Krishnaswami, Reaction between butyl alcohol and ammonia under pressure, III, 112.
- Muthna, M. S. and J. C. Ghosh, Studies on Walden inversion : Kinetics of conversion of l-Bromo succinic acid to d-B malo lactonic acid (Part I); and Hydrolysis of d-B, malo lactonic acid to l- or d- malic acid (Part II), III, 125.
- Muthu, M., S. K. Majumdar and S. V. Pingale, A Bacterial Disease of *Heliothi obsoleta* F., a Pest of Vegetable and Fruit Crops, III, 379.
- Muthu, M., S. K. Majumdar and S. V. Pingale, A Bacterial Disease of *Heliothi obsoleta* F., a Pest of Vegetable and Fruit Crops, III, 379.

N

- Nadkarni, G. B. and V. A. Patwardhan, on the chemical composition of the Mucilage from the seeds of *Ocimum sanctum*, Linn., (Tulsi), III, 167.
- Nag, M. K., Family Structure of the Kanikkar and the Urali of Travancore, III, 325.
- Nagabhushanam, R. and P. N. Ganapati, Biology of Some Marine Wood Boring Organisms of Visakhapatnam Harbour, III, 315.
- Naha, Kshitindra, Kyanite-Chloritoid-Schists from North-eastern Mayurbhanj, III, 190.
- Naha, Kshitindra Mohan, Norite Intrusions in South Dhalbhum and North eastern Mayurbhanj, III, 191.
- Naha, K. and S. Ray, Sylhet Traps—a Local Petrographic study, III, 191.
- Naha, Kshitindra Mohan, Triclinic Chloritoid from N. E. Mayurbhanj and its Optical Characters, III, 183.
- Nair, A. P. Madhavan and S. Subrahmanyam, Studies on the low temperature carbonisation of South Arcot lignite and on the properties of the products obtained, III, 152.
- Nair, P. P. and N. G. Magar, Molybdenum content of some Indian Pulses, III, 145.
- Nair, P. P. and N. G. Magar, Estimation of Total Tocopherols in Blood, III, 82.
- Nambury, C. N. Vasudevan and P. N. Bhargava, Preparation of S-di-o-tolyl thio-barbituric Acid, III, 123.
- Nanda, R. K., H. K. Pujari and M. K. Rout, p-Tolyl-Thiohydantion and its derivatives and their use as analytical reagents, III, 112.
- Nanda, M. and R. Mohanty, On the Logarithmic mean of the Derived Conjugate series of a Fourier Series, III, 2.
- Nandi, P. N. and S. K. Mukherjee, Antibiotic activities of some fungi from the soils West Bengal, III, 220.
- Nandi, P. and A. K. Banerjee, Biological studies on a strain of *Streptomyces* producing an antifungal antibiotic, III, 221.
- Nandi, P., S. B. Ghosh and G. P. Sen, Studies on counter-current distribution and applications, Part II, III, 110.
- Nandi, D. K. and S. K. Bhattacharyya, Thermal Decomposition of Formaldehyde at High Pressure, III, 102.
- Nandi, S. K. and B. C. Dutta, Fine Crushing of Coal in Ball Mill, III, 414.
- Nandi, S. K. and N. K. Roy Chaudhury, Solvent Extraction of Cotton Seed Oil, III, 161.
- Nandy, Sudhish and Ramprasad Banerjee, Observations of the action of papain on casein, III, 147.
- Nandy, Sudhish and Ramprasad Banerjee, Case in viscosity in proteinase evaluation, III, 105.
- Nandy, K. P., Multiquadrant Graphs for functions of n-variables, III, 6.
- Naik, S., The action of Beta Indolyl butyric acid on the rate of growth of *Pisum arvense*. L., III, 256.
- Naidu, N. Bhojraj and S. A. Saletore, Preparation of Castor-modified Alkyds by "the Drying Alkyds Castor Process": Part I, III, 168.
- Naidu, M. B. and S. H. Zaheer, Laboratory and field tests for the control of *Eupterote mollifera*, III, 292.
- Naidu, N. Bhojraj and S. A. Saletore, Preparation of Castor Modified Alkyds by 'the Monoglyceride Method' using without catalysts and azeotropic solvent xylol. Part II, III, 131.
- Naidu, N. Bhojraj and S. A. Saletore, Preparation of Castor Modified Alkyds by the "Monoglyceride method" using the catalysts and azeotropic solvent Xylol. Part III, 132.
- Naidu, N. Bhojraj and S. A. Saletore, A Modified Laboratory set up for Alkyd Preparation, III, 172.
- Naidu, S. G., M. C. Nath and C. H. Chakrabarti, Effect of Methionine and Casein on Acetoacetate induced Hyperglycemia, III, 385.
- Narahari, P., M. S. Powar and V. V. Suryanavavana Murty, Patterns of flowering in the improved rice varieties of Hyderabad, III, 360.
- Narain, Kedar and S. M. Mathur, On the Jungel Series, III, 178.
- Narang, N., Contributions to the life history of *Ephedra campylopoda*, III, 223.
- Narang, N., Contributions to the life history of *Ephedra campylopoda*, III, 224.
- Narasimhamurthy, C. C. and Kandula Pampapathi Rao, Studies on the sympathetic nervous system of reptiles: Cytoplasmic inclusions of the sympathetic neurons of the garden lizard, *Calotes versicolor* and the limbless lizard, *Barkudia*, III, 277.
- Narasimhamurthy, C. C. and Kandula Pampapathi Rao, Studies on the osmotic properties of internal parasites of poikilotherms: Observations on the behaviour of *Gregarina poecilocerum* under heterosmotic conditions, III, 282.

- Narasimhan, R. K. and G. Bandyopadhyay, A Special Technique of Relaxation Methods in Simultaneous Equation, III, 415.
- Narayanawami, S., Sedimentary Facies of the Charnockitic series, III, 190.
- Narayanan, E. S. and S. Z. Haider, Some Physical and Physiological Factors Governing the Sex-ratio on *Bracon* (*Microbracon*) *gelechiae* Ashmead (Hymenoptera : Braconidae), a larval parasite of the Potato tuber moth, *Gnorimoschema* (*Phthorimaea*) *operculella* (Lepidoptera : Gelechiidae), III, 296.
- Narayanan, E. S. and K. R. Thakare, Confirmation of the Number of Larval Instars in the Genus *Bracon* by the Application of Dyar's principle, III, 299.
- Narayanan, E. S. and K. R. Thakare, Studies on the Immature Stages of the Genus *Bracon* and the Genus *Stenobracon* (Hymenoptera : Braconidae), III, 298.
- Narayanan, E. S. and S. Z. Haider, Some Physical and Physiological Factors Governing the Sex-ratio on *Bracon* (*Microbracon*) *gelechiae* Ashmead (Hymenoptera : Braconidae), a larval parasite of the Potato tuber moth, *Gnorimoschema* (*Phthorimaea*) *operculella* (Lepidoptera : Gelechiidae), III, 296.
- Narayanan, E. S. and K. R. Thakare, Bionomics and Biology of *Chelonus narayani* Sp. Nov. (Hymenoptera : Braconidae), an Egg Larval Parasite of the Gram Caterpillar *Heliothis armigera* (Fabr.), III, 297.
- Narayana, R., Floral Morphology and Embryology of *Nuytsia Floribunda* (Labill.) R.Br., III, 239.
- Nargund, K. S. and S. N. Munvalli, Substituted Quinoline Acetic Acids,—Part I, III, 116.
- Nargund, K. S. and V. S. Devasthale, Preparation of dichloro propiophenones and *o*-dichloro phenyl propionic acids, III, 117.
- Nath, M. C., C. H. Chakrabarti and S. G. Naidu, Effect of Methionine and Casein on Acetoacetate induced Hyperglycemia, III, 285.
- Nath, M. C., C. H. Chakrabarti and S. G. Naidu, Effect of Methionine and Casein on Acetoacetate induced Hyperglycemia, III, 385.
- Nath, Bhola, The Delphinine alkaloid, III, 138.
- Nath, Bhola, The Delphinine alkaloid, III, 138.
- Nath, M. C. and V. K. Sahu, Occurrence of Glucose in combination with Acetoacetate in normal urine, III, 386.
- Nath, M. C. and C. H. Chakrabarti, Biosynthesis of ascorbic acid and prevention of glycogen depletion in Liver and Muscle, III, 146.
- Natural Regions of India, IV, 73.
- Navalkar, B. S. and S. M. Betrabet, Physical and Chemical Properties of Bast Fibres in relation to their Intrinsic Strength, III, 226.
- Navalkar, B. S., Humus Content of Mangrove Soils of Bombay and Salsette Islands, III, 241.
- Nayak, Miss P. D., Miss M. R. Varde and D. V. Bal, The Air-bladder and its Relation with the Auditory Organ of *Hilsa tili*, III, III, 302.
- Nayar, K. K. and G. P. Sharma, A Study of the Cytolplasmic Inclusions during the Spermatogenesis of the Domestic fowl, *Gallus domesticus*, III, 274.
- Nayer, P. S. and P. S. Sreenivasan, The Physical Significance of the Growth constants of the Skew Logistic Elongation Curve of Sugarcane Crop, IV, 2.
- Nayudamma, Y. and D. Ramaswamy, Studies in Vegetable Tanning—(Part IV) : Determination of Different kinds of Acids and Salts in Tanliquors by Non-aqueous Titration Technique, III, 92.
- Nayudamma, Y. and R. Selvarangan, Studies in Chrome Tanning—Part I : Complexing properties of certain salts of Inorganic Acids, III, 172.
- Non-Linear Vibrations, IV, 23.
- Nigam, V. N., B. Biswar and G. N. Gupta, Preparation of activated carbon from Kana (*Spaccharum Sponatanum*), III, 169.
- Niyogi, N. C. and C. C. Basak, Studies on Fischer-Tropsch Synthesis : Part V. Effects of Different Iron Catalysis at Atomospheric Pressure, III, 174.
- Niyogi, D. and Bhagwan Das, Geology of the Area Round Simultala, Bihar, III, 177.
- Niyogi, Binayendra Narayan, Petrology and Metamorphic facies correlation of Amphibolites of the Archaean Region Northwest of Abhayapuri, Assam, III, 188.
- Nuclear Structure, IV, 46.

O

- Ojha, D. N., The Gabbro Rocks around Jeria Dungri, Saraikela, Singhbhum District, III, 200.
- Ojha, V. N. and S. P. Pathak, Chemical study of the oil of Radish Seed, III, 149.
- Oza, T. M., V. T. Oza and R. H. Thaker, The Thermal Decomposition of Silver Nitrite, III, 88.

- Oza, V. T., T. M. Oza and R. H. Thaker, The Thermal Decomposition of Silver Nitrite, III, 88.

P

- Pai, M. L. and J. D. Pathak, Results of Fractional Gastric Analysis in Normal Indians, IV, 18.
- Pal, K., S. N. Luktuke, S. K. De and P. Bhattacharya, Studies on ascorbic acid content in the semen of hill bulls and buffalo bulls and its correlation with the seminal fructose and semen equality, III, 400.
- Pal, A. K., S. Bose and S. G. Iyer, Studies on the Effect of the Addition of Yeast Sludge in Normal and Simplified Laying Rations, III, 344.
- Pal, P. R. and S. C. Ray, A synthetic homologue of pteric acid, III, 142.
to Submerged Timber in the Bombay Harbour, III, 313.
- Palekar, V. C. and D. V. Bal, A Preliminary Note on the Marine Organisms Injury to Submerged Timber in Bombay Harbour, III, 313.
- Pande, S. K. and K. P. Srivastava, On a New Species of *Cephalozia* Dum. from Pachmarhi, Madhya Pradesh, III, 222.
- Pande, C. S. and M. P. Bhatnagar, Formation of Complex Compounds between Urea and Alkaline Earth Halides—Pt. V. The System: $\text{BaBr}_2\text{-CO(NH}_2)_2\text{-H}_2\text{O}$ (Conductivity and Viscosity).
- Pande, C. S. and M. P. Bhatnagar, Formation of Complex Compounds between Urea and Alkaline Earth Halides—Pt. IX. The System: $\text{BaI}_2\text{-CO(NH}_2)_2\text{-H}_2\text{O}$ (Refractive Index and Freezing Point), III, 87.
- Pande, C. S. and M. P. Bhatnagar, Formation of Complex Compounds between Urea and Alkaline Earth Halides—Pt. VIII. The System: $\text{BaI}_2\text{CO(NH}_2)_2\text{-H}_2\text{O}$ (Conductivity and Viscosity), III, 87.
- Pande, C. S. and M. P. Bhatnagar, Formation of Complex Compounds between Urea and Alkaline Earth Halides—Pt. VII. The System: $\text{BaBr}_2\text{-CO(NH}_2)_2\text{-H}_2\text{O}$ (Rheochor, Parachor and Molecular Refraction), III, 87.
- Pande, C. S. and M. P. Bhatnagar, Formation of Complex Compounds between Urea and Earth Halides—Pt. VI. The System: $\text{BaBr}_2\text{-CO(NH}_2)_2\text{-H}_2\text{O}$ (Surface Tension and Refractive Index), III, 86.
- Padhi, B., Occurrence of *Humaria* in India, III, 218.
- Padhi, B., Leaf Scorch of *Pongamia glabra*, III, 219.
- Pande, G. D. and S. P. Pathak, The component acids of the Indian Sahjan fat, III, 158.
- Pani, S. and G. Patra, The Study of Lactate Complex of Trivalent Antimony by Glass Electrode, III, 83.
- Pani, S. and D. V. Raman Rao, A Pseudo unimolecular Reaction: Reduction of molybdate by thiosulphate, III, 98.
- Pani, S. S. and G. P. Chatterjee, Studies on the Ionic Nature of Molten Alloys with Particular Reference to Al-Si Alloys, III, 430.
- Pandey, S. C., Om Prakash and Atma Ram, Elimination of Ground Oil, III, 162.
- Pandey, S. C., Om Praflash, Atma Ram and V. D. Athawale, Isomerisation of Linseed Oil, III, 162.
- Pandeya, S. C., Biological Spectra of 8 Grassland Associations near Sagar, M.P., III, 243.
- Pandeya, S. C., Notes on Autecology of *Iseilema Anthephoroides* Hack, III, 243.
- Pannirselvam, S., On the Vernalizations of bulbs of Onion and Garlic, III, 255.
- Pannirselvam, S., Photoperiodism in Relation to Factorial Lights, III, 266.
- Panja, G., Our First and Foremost Approach to the Prophylaxis of Leprosy in India, III, 333.
- Panja, G., Tricophytin Test for Diagnosis of Ringworms, III, 333.
- Pantulu, A. Jogi, and P. N. Bhargava, Studies on 3-m-tolyl-2:4-thiazolidione, III, 123.
- Panigarhi, G., Cyto-taxonomical studies on the *Cyclosorus parasiticus* complex and the *Asplenium aethiopicum* complex, III, 244.
- Pant, C. M. and K. P. Shukla, Staunching of Canals, III, 417.
- Pant, C. M. and K. P. Shukla, Electro-Chemical Treatment of Clays. Part III, III, 96.
- Pathak, S. P. and P. N. Suwal, Comparative study of fats from mature (mother) and immature (embryo) shark (*Galeocerdo Tigrinus*) liver oils, III, 159.
- Pathak, S. P. and L. M. Dey, Component Fatty Acids of the Seed fat of *Pongamia Glabera* (Karanja), III, 160.
- Pathak, S. P. and S. S. Mathur, The Component Acids and Glycerides of Arecanut (*Areca catechu*) fat, III, 160.
- Pathak, S. P. and G. D. Pande, The component acids of the Indian Crocodile fat, III, 159.

- Pathak, S. P. and G. D. Pande, The component acids of the Indian Sahjan fat, III, 158.
- Pati, T., On the Absolute Riesz Summability of Fourier series, its Conjugate series and their Derived series, III, 4.
- Patil, K. Z. and C. R. Talpade, Role of Inductomeric effect in the decomposition of Diazonium Chlorides, III, 105.
- Patil, H. N. and D. V. Gogate, A Study of temperature Variation in convected Air-streams, III, 37.
- Patil, K. Z., Estimation of Diazonium Salts, III, 82.
- Patil, B. S. and N. R. Tawde, Rotational temperature lag in CH(4315) and CH(3900) bands in a Flame, III, 27.
- Patil, H. N. and D. V. Gogate, A study of temperature variation in convected Air-streams, III, 37.
- Parakh, V. M., T. R. Ingle and B. V. Bhide, Chemical investigation of "Bael mucilage" (*Aegle marmelos*; N. O. Rutaceae) Part I:—Composition of Bael mucilage, III, 140.
- Paria, Gunadhar, Stress Distribution in a Thin Plate having Parabolic boundary due to a concentrated force as the focus, III, 10.
- Parkhi, (Miss) Sindhu and Suresh Sethna, Synthesis of some 2-methyl chromone and flavone carboxylic acids, III, 115.
- Parikh, V. M., T. R. Ingle and B. V. Bhide, Chemical investigation of Modal Gum. (*Lannea grandis*; N. O. Anacardiaceae), Part I:—Composition of Modal gum, III, 140.
- Parikh, V. M., T. R. Ingle and B. V. Bhide, Chemical investigation of Modal Gum. (*Lannea grandis*; N. O. Anacardiaceae). Part II:—Structure of the aldobionic acid, III, 140.
- Parikh, V. M., T. R. Ingle and B. V. Bhide, Chemical investigation of Modal Gum. (*Lannea grandis*; N. O. Anacardiaceae), Part I:—Composition of Modal gum, III, 140.
- Parikh, V. M., T. R. Ingle and B. V. Bhide, Chemical investigation of "Bael mucilage" (*Aegle marmelos*; N. O. Rutaceae), Part I:—Composition of Bael mucilage, III, 140.
- Parikh, V. M., T. R. Ingle and B. V. Bhide, Chemical investigation of Modal Gum. (*Lannea grandis*; N. O. Anacardiaceae), Part II:—Structure of the aldobionic acid, III, 140.
- Parikh, N. M. and C. C. Shah, Mineral Nutrition of Common Crops of Guparat. Effect of Manganese Part II. Absorption of Calcium, Manganese, Phosphorus and Nitrogen, III, 377.
- Parikh, N. M. and C. C. Shah, Mineral Nutrition of Common Crops of Gujarat. Effect of Manganese Part III. Absorption of Iron, III, 376.
- Parsai, P. S., Top orking of inferior type of fruit trees to superior commercial varieties, III, 372.
- Parshad, Ram and G. P. Sharma, Structure and behaviour of the chromosomes in the wild population of *Halys dentatus* (Hemiptera-Heteroptera), III, 275.
- Parthasarathy, M. D. T. Subramania Pillai and V. K. Sundaraja Iyengar, Histological and Histochemical Studies on the Coxal glands of *Palamnaeus gravimanus* Thorell, III, 269.
- Parulekar, (Miss) N. K., Stem anatomy of Convolvulaceae, III, 229.
- Pate, C. C., D. P. Kharkar and M. R. A. Rao, Carbides of Titanium, III, 82.
- Patel, B. M. and H. S. Patel, Loss of Vitamin A potency during the preparation of ghee from milk, IV, 15.
- Patel, B. M. and H. S. Patel, Vitamin A potency of colostrum milk of Kankraj cows, IV, 16.
- Patel, D. K. and V. S. Lad, Effect of continuous growing of the same crop and rotational system of cropping on soil fertility, III, 363.
- Patel, G. I. and R. M. Datta, Cytogenetical Investigations of X-ray induced mutations in Jute (*Corchorus Olitorius* Linn.), III, 244.
- Patel, B. R., G. W. Chiplonkar and P. N. Jagatap, A Preliminary Note on the Dykes of Hirapur-Narwa area in Saugor District, Madhya Pradesh, III, 203.
- Patel, H. S. and B. M. Patel, Loss of Vitamin A potency during preparation of ghee from milk, IV, 15.
- Patel, H. S. and B. M. Patel, Vitamin A potency of colostrum milk of Kankraj cows, IV, 16.
- Patel, S. R. and M. J. Sach, Synthesis of 5-methyl-acridine derivatives, III, 127.
- Patel, S. R. and M. J. Sach, Studies in Friedel-Craft's Reaction: Friedel-Craft's Acetylation of Aceto *o*-Toluidide, III, 127.
- Patel, S. R., G. S. Mewada and N. M. Shah, Synthesis of 2:8-dimethyl-3-substituted-4-quinazolones, III, 126.

- Patel, D. P. and V. M. Thakor, Synthesis of some 1:4-Benzopyranols, III, 128.
- Patel, C. C. and D. P. Kharkar, Peroxalates of Titanium, III, 83.
- Patel, C. C. and B. R. Lakshmana, Spectrophotometric studies on thorium and uranium complexes of morellin, III, 99.
- Pattnaik, H. and B. Samantari, Rooting response of the Twings of *Aristolochia Gigas*, Lindl, III, 257.
- Pathak, C. H., Effect of Pre-emergence treatment with 2,4-D on Weeds in corn and on Various soil properties, IV, 17.
- Pathak, J. D. and M. L. Pai, Results of Fractional Gastric Analysis in Normal Indians, IV, 18.
- Pathak, S. P. and V. N. Ojha, Chemical study of the oil of Radish Seed, III, 149.
- Patra, G. and S. Pani, The Study of Lactate Complex of Trivalent Antimony by Glass Electrode, III, 83.
- Patwardhan, V. A. and V. G. Sonar, Fatty Oil and Non-Fatty matter from the seeds of *Thespesia populnea*, Linn., III, 167.
- Patwardhan, V. A. and G. B. Nokarni, On the chemical composition of the Mucilage from the seeds of *Ocimum sanctum*, Linn. (Tulsi), III, 167.
- Patwardhan, V. A., M. A. Shaikh and P. S. Javadekar, Non-fatty Matter from the Seeds of (i) *Ocimum Basilicum*, Linn., and (ii) *Ocimum canum*, Sims, III, 171.
- Paul, S. D. and M. R. Verma, Volumetric method for the Determination of Zirconium, III, 80.
- Patwardhan, N. K., Testing of Building Stones, III, 417.
- Paul, S. D. and M. R. Verma, Spot-test method for the detection of cadmium in presence of copper, tin and lead, III, 80.
- Pendse, H. K. and S. D. Limaye, Synthesis of 2-4'-dimethyl-8'-acetyl-6'-7'-furocoumarin, III, 115.
- Perraju, P. and M. N. Deekshitulu, Chronite Deposits of Maruabil, Dhenkanal district, Orissa, III, 207.
- Peter, C. T. and H. D. Srivastava, *Cercaria ratnagiriensis*, N.Sp., A Megalurous cercaria from *Paludomus obesa* (Philippi), III, 284.
- Peter, C. T., Echinostome Cercariae from Bareilly, with the Description of a New Species, III, 285.
- Peter, C. T. and H. D. Srivastava, On five New Species of Amphistome Cercariae from India, III, 353.
- Peter, C. T., A Note on the Pre-cercarial Development of *Pseudodiscus Collinsi* (Cobbold, 1875) Sonsino, 1895, III, 353.
- Phansalkar, V. K. and S. K. K. Jatkar, Dielectric Constant and Dipole Moment of the Esters of Monocarboxylic Acids (part I), III, 33.
- Phansalkar, V. K. and S. K. K. Jatkar, Dielectric Constant and Dipole Moment of the Esters of Dicarboxylic Acids, III, 34.
- Phatak, V. G. and (Miss) K. B. Ambegaokar, Embryological Studies in *Acanthaceae*: The Female Gametophyte, III, 227.
- Phadke, K. R. and S. V. Chandrashekhar Aiyar, Atmospheric Noise Level in the 5 Mc/s Bank at Poona, III, 421.
- Pingale, S. V., Contamination of the Grain stored in Jute bags through surface dusting with BHC, III, 380.
- Pingale, S. V., S. K. Maumder and M. Muthu, A Bacterial Disease of *Heliothi obsoleta* F., a Pest of Vegetable and Fruit Crops, III, 379.
- Pingale, S. V., Impregnation of Jute bags with Insecticides for the Insectfree Storage of Food Grains, III, 380.
- Pingale, S. V., S. K. Maumder and M. Muthu, A Bacterial Disease of *Heliothi obsoleta* F., a Pest of Vegetable and Fruit Crops, III, 379.
- Pingale, S. V., Contamination of the Grain stored in Jute bags through surface dusting with BHC, III, 380.
- Pingale, S. V. and M. V. Sharangapani, A study of the movement of some insect pests, through grains stored in bags, III, 294.
- Pingale, S. V. and K. K. Dole, Adsorption and Desorption of Organic Molecular Compounds, III, 94.
- Pingale, S. V., Impregnation of Jute bags with Insecticides for the Insectfree Storage of Food Grains, III, 380.
- Pillai, T. Subramania. M. D. Parthasarthy and V. K. Sundaraia Iyengar, Histological and Histochemical Studies on the Coxal glands of *Palamnaeus gravis* Thorell, III, 269.
- Pillai, V. N. Krishna and S. C. Chakravarti, The effects of certain synthetic growth regulators on the vernalization of *Brassica campestris* L., III, 253.
- Pillay, P. P. and K. G. Das, Chonemorphine: an alkaloid from the roots of *Chonemorphia macrophylla*, III, 130.
- Plant Breeding methods in Relation to Physiological and Biochemical Characters, IV, 102.

- Plant Introduction as an aid to improvement of Food and Fodder, IV, 108.
- Poddar, Sailendra Nath, Ortho-Hydroxyacetophenone Oxime as an Analytical Reagent for the Colorimetric Estimation of Iron and Uranium, III, 79.
- Ponniah, Miss Stella, On the effect of musical sounds of stringed instruments on the growth of plants, III, 255.
- Ponniah, Miss Stella and T. C. N. Singh, On the response of structure of the leaves of Balsam and Mimosa to the Musical sounds of Violin, III, 254.
- Powar, M. S., P. Narahari and V. V. Suryanavayana Murty, Patterns of flowering in the improved rice varieties of Hyderabad, III, 360.
- Premvati, *Cercaria reinforma* n.sp.—A new Monostome *Cercaria* from the snail, *Melanoides flavidus*, III, 285.
- Padmavati, P. B. and B. R. Seshachar, Origin of Micronuclei in *Spirostomum ambiguum* H., III, 269.
- Pujari, H. K. and M. K. Rout, 2-p-chloro-phenyl-imino 4-thiazolidone and its condensation products and their use as analytical reagents, III, 114.
- Pujari, H. K., R. K. Nanda and M. K. Rout, p-Tolyl-Thiohydantoin and its derivatives and their use as analytical reagents, III, 112.
- Pujari, H. K. and M. K. Rout, N-p-Tolyl Rhodanime and its derivatives, III, 113.
- Purakayastha, M., A. K. Mishra and A. Das Gupta, Survey of antibiotic-producing actinomycetes from Indian Soils IV, III, 220.
- Puri, S. N., A. G. Jhingran, S. M. Mathur and R. S. Sharma, A Study of the Bundelkhand Granite in Chhatarpur District, Vindhyia Pradesh, III, 195.
- Puri, Balwant Rai, Acidoid Value and Surface Area of Soil Separates, III, 89.
- Purohit, B. L. and R. M. Kalapesi, Rhinosporidiosis in Bovines in Bombay State, III, 349.
- Prabhu, S. S., Influence of factors affecting sex drive on semen production of buffaloes—II, III, 348.
- Prabhu, V. R. and M. S. Honrao, A study in Coastal Settlements, North Kanara District, Bombay State, IV, 9.
- Prakash, Om, T. R. Sharma and Amanullah Khan, A Study of the Forest Oilseeds : *Albizia labbek* and *Albizia procera* and their Oils. Part I, III, 162.
- Pakrashi, S. and A. Chatterjee, Studies on the Steric hindrance to N-acylation of Indole-NH group in Rauwolfscine, the Alkaloid of *Rauwolfia canescens*, Linn., III, 136.
- Prakash, Ishwar and Daya Krishna, Ecological studies of the mammals of Rajasthan desert. Hedgehogs : Fossorial habits, III, 310.
- Prakash, Ishwar and Daya Krishna, Ecological studies of the mammals of Rajasthan desert : Distribution, III, 310.
- Prakash, Ishwar and Daya Krishna, Ecological studies of the mammals of Rajasthan desert. Hedgehogs : Rolling, III, 311.
- Prakash, Ishwar and Daya Krishna, Ecological studies of the mammals of Rajasthan desert. Hedgehogs : Feeding habits, III, 311.
- Prakash, Ishwar and Daya Krishna, Ecological studies of the mammals of Rajasthan desert. Gerbilles, III, 311.
- Prakash, Or, Atma Ram and S. C. Pandey, Elimination of Groundnut Oil, III, 162.
- Prakash, Om, T. R. Sharma and Amanullah Khan, Preparation of Activated Carbons from the waste materials of the Oil Industry viz. the Shell (Husks) of Neem, Castor and Mahua Seeds, III, 161.
- Prakash, Om, Atma Ram, V. D. Athawale and S. C. Pandey, Isomerisation of Linseed Oil, III, 162.
- Pramanik, H. R., Particle size determination through settling processes, III, 419.
- Prasad, M. R. N., Reproductive cycle of the male Indian Gerbille, *Tatera indica cuvieri* (Waterhouse), III, 310.
- Prasad, B. N. and S. N. Bhatt, On the Summability Factors of a Fourier Series, III, 1.
- Prasad, S. N. and B. P. Gyani, Reduction of Potassium Permanganate by Iodide and Bromide ions in Presence of Sulphuric Acid, III, 90.
- Prasad, K. N. and P. C. Hazra, Some observations on the stratigraphy and tectonics of the region north of the Banihal Pass, Kashmir, III, 179.
- Prasad, Kailash Chandra and Durganand Singh, A study of Job Satisfaction in Office and Manual Workers, III, 412.
- Prasad, R. and S. K. Singh, Some Diode-gating Techniques for Obtaining Decade Scaling from Binary Scalers, III, 427.
- Problems of Co-Ordination of Statistical Activities, IV, 33.
- Pruthi, J. S. and Girdhari Lal, Refrigerated storage of purple passion fruits (*Passiflora edulis* Sims), IV, 16.
- Pruthi, J. S. and Girdhari Lal, Studies on the nutritive value and utilisation of purple passion fruits (*Passiflora edulis* Sims), IV, 16.
- Pruthi, J. S. and Girdhari Lal, Germination trials on passion seeds (*Passiflora edulis*), IV, 17.

R

- Radha, Miss V. and K. Ramchandran, Chemical Activities of *Pseudomonas fluorescens*, III, 131.
- Rai, Bhuwan Prakash and Chandra Bal, On the occurrence of *Stenophora* sp. in the midgut of *Blatta Orientalis*, III, 281.
- Rai, R. S. and S. Ghosh, Studies in the change of Hydrogen Ion concentration Colloidal Ferric Hydrrous Oxide Sol during its coagulation by Potassium Sulphate, III, 109.
- Raj, Des, Some estimators in sampling with varying probabilities with replacement, III, 17.
- Rajalakshman, D. V. and M. Madhusudana Rao, Some properties of a simple stochastic model with time-tending coefficients, III, 19.
- Rajeswari, V. and N. R. Tawde, Swan Bands in Rare Gases : Part I—Some peculiar features of the Development, III, 28.
- Rajeswari, V. and N. R. Tawde, Swan Bands in Rare Gases : Part II—Role of the nature of rare gas and its pressure in transition probabilities, III, 29.
- Rakshit, R. C. and D. K. Majumdar, The Phase diagram study of some Binary system, III, 92.
- Rakshpal, R., Respiratory system of *Cryllotalpa africana* Beauvois (Orthoptera), III, 293.
- Ram, Atma, Om Prakash and S. C. Pandey, Elimination of Groundnut Oil, III, 142.
- Ram, Atma, Om Prakash, V. D. Athawale and S. C. Pandey, Isomerisation of Linseed Oil, III, 162.
- Ramaiah, N. R., Decomposition of Hydrogen Peroxide Vapour under Electric Discharge, III, 97.
- Ramaiah, N. A. and H. C. Gaur, On Geiger Region of A/C Electric Discharge, III, 30.
- Ramakrishna, V. and K. R. Krishnaswami, Hydrogenation of Ethylene at 0°C on Cobalt catalyst, III, 112.
- Ramakrishnan, C. V., Mechanism of Citric Acid Formation and Accumulation in *Aspergillus Niger*, III, 384.
- Ramakrishnan, C. V., Mechanism of Citric Acid Formation and Accumulation in *Aspergillus Niger*, III, 384.
- Ramchandran, K. and Miss V. Radha, Chemical Activities of *Pseudomonas fluorescens*, III, 131.
- Ramchandran, V. S. and S. K. Bhattacharyya, Thermal Decomposition of Chromic Trioxide, III, 83.
- Ramchandran, V. S., Miss S. Kameswari and S. K. Bhattacharyya, Differential Thermal analysis of Catalyst powders : System : $\text{ThO}_2\text{Al}_2\text{O}_3$, III, 100.
- Ramakanth, J., Flexure of Composite beam of Rectangular Cross-sections with a common side, III, 11.
- Ramalingam, K. and K. S. Chari, Solvent Extraction of Vegetable Oils—Part I. Solubility of Safflower Oil in ethyl alcohol, III, 152.
- Ramasastri, C. and S. V. Lakshmi Narayana Rao, Surface Features of Magnetite, III, 183.
- Ramaswami, L. S., Hormones and Secondary Sex characters in the Minnow *Hyborynchus*, III, 280.
- Ramaswamy, D. and Y. Nayudamma, Studies in Vegetable Tanning—(Part IV) : Determination of Different kinds of Acids and Salts in Tanniquors by Non-aqueous Titration Technique, III, 92.
- Rammurthy, H. and M. K. Ganguli, Salinity pattern in the river Hooghly, III, 20.
- Ranadive, N. S., K. S. Korgaonkar and N. B. Sahasrabudhe, Chemical effects of ionizing radiations on solutions of Nucleic Acid, Purine and Pyrimidine bases by Spectroscopic Method, III, 147.
- Rangarajan, S., Influence of Solar Activity on Weather, IV, 5.
- Rangaswami, K., Studies on the influence of Vernalization on the Mitotic behaviour of *Allium cepa*, Linn. (Ballary Onion) and *Allium sativum*, Linn. (Garlic), III, 245.
- Rangneker, P. V., Oxygen-carrying capacity of the blood of some crustaceans and molluscs, III, 280.
- Ranjini, P. V. and Chandra Bal, On the occurrence of *Opalina scalpriformis* in the rectum of *Rana tigrina*, III, 281.
- Rao, B. V. Venkata Rao and S. V. Govindarajan, Liquid Ammonia as a Fertilizer—some preliminary soil studies on Nitrogen Transformations, III, 368.
- Rao, S. Rammohan and L. S. Hiregaudar, A Note on *Syringophilus Bipectinatus* (Heller, 1880)—A Quill Mite of Domestic Fowl in India, III, 354.
- Rao, S. R., An Out Post of Harappa Culture, IV, 14.
- Rao, S. R. and L. S. Hiregaudar, A Note on the little known forms of *Taenia* (Cyclophylidae), III, 350.

- Rao, S. Rammohan and M. Y. Bhatavdekar, Further Observations on the Species of Coccidia Affecting Dogs and Cats with Particular Reference to a New Coccidium Belonging to the Genus Eimeria, *II*, 350.
- Rao, V. Seetharama, T. K. Krishnan and T. D. Mahadevan, The Influence of Caponisation on the Carcass Composition, Edible Meat content and Palatability of Chicken of the Same Age and Breed, *III*, 346.
- Rao, S. R. V., Chromosome studies in the three species of Homoptera, *III*, 276.
- Rao, K. S., Simultaneous Estimation of Parameters in Multiple Regression Analysis with Correlated Residuals, *IV*, 3.
- Rao, Kandula Pampapathi and C. C. Narasimhamurthy, Studies on the osmotic properties of internal parasites of poikilotherms: Observations on the behaviour of Gregarina poecilocercum under heterosmotic conditions, *III*, 282.
- Rao, K. Sanjeeva and D. V. S. Reddy, Effect of pressure variations in Carotid Sinus on Intestinal movements of the adrenalin, Noradrenaline and acetylcholine, *IV*, 19.
- Rao, S. B. V. and B. M. Thakral, Successful Chemotherapy of Avian Pasteurellosis with Sulphamezathine, *III*, 346.
- Rao, M. Appaswamy and B. A. Gulani Ahmad, Histological changes of the thymus of Loris lydekkerianus (Cabr), *III*, 309.
- Rao, M. Rama, Ultrasonic Velocity and molecular Volume, *IV*, 4.
- Rao, Kandula Pampapathi, Enteropneusta from Madras and the Gulf of Manasar, with a note on the probable course of distribution of Ptychodera flava Eschscholtz, *III*, 301.
- Rao, S. R. V., Spermatogenesis in Eurybrachis (Fulgoridae-Homoptera), *III*, 276.
- Rao, Kandula Pampapathi and G. Balakrishnamurthy, Preliminary observations on the zonation of the fauna and flora of the intertidal rocks at Waitair, *III*, 315.
- Rao, Kandula Pampapathi, Two species of Enteropneusts from off the coast of Madras, *III*, 301.
- Rao, K. Hanumantha and P. N. Ganapati, On the occurrence of Metacercariae cysts of a Diplostome (Trematoda) in Fresh-water Fishes, *III*, 285.
- Rao, C. Venkata, Embryological Studies in Palmae—I, *III*, 230.
- Rao, C. Venkata and S. Rama Rao, Embryology of Two Asclepiadaceae, *III*, 232.
- Rao, Kandula Pampapathi and C. C. Narasimhamurthy, Studies on the sympathetic nervous system of reptiles: Cytoplasmic inclusions of the sympathetic neurons of the garden lizard, Calotes versicolor and the limbless lizard, Barkudia, *III*, 277.
- Rao, Seshagiri, A Revision of the Indo-Malayan species of Viscum Linn., *III*, 228.
- Rao, N. S. and B. C. Kundu, Origin and Development of Axillary Buds in Hibiscus cannabinus, *III*, 229.
- Rao, S. Rama and C. Venkata Rao, Embryology of Two Asclepiadaceae, *III*, 232.
- Rao, T. L. Narasimha and D. S. Datar, Studies on Vapour Adsorption by Active Carbons prepared from Indigenous Materials, *III*, 152.
- Rao, S. V. L. N., D. Venkateswarlu and N. K. Roy Chaudhury, Extractives of South Arcit Lignites, *III*, 166.
- Rao, M. R. A. and M. A. Cohly, A micro-electrophoretic study of the interaction between sodium dodecyl sulphate and crystalline bovine plasma albumin, *III*, 144.
- Rao, T. L. Narasimha and D. C. Datar, Studies on Caramel Decolorisation by Active Carbons from Indigenous Materials, *III*, 152.
- Rao, T. L. Narasimha and D. S. Datar, Active carbon from Coke obtained by low temperature carbonisation of Singreni Coal, *III*, 151.
- Rao, B. Y., T. N. Mehta and M. P. Kulkarni, Solvent Segregation of Linseed Oil and Safflower Oil by Ethyl Alcohol, *III*, 148.
- Rao, S. Rammohan and L. S. Hiregaudar, A New Species of Tropiculid Mite from a rat snake in Bombay, *III*, 287.
- Rao, M. Madhusudana and D. V. Rajalakshman, Some properties of a simple stochastic model with time-trending coefficients, *III*, 19.
- Rao, M. R. A. and Ashma Aga, The adsorption of gases on metal powders at low temperatures, *III*, 110.
- Rao, M. R. A. and U. N. Bhrany, Studies on Oxo reaction with Alicyclic compounds, *III*, 112.
- Rao, I. Achyuta and V. Ramakrishna Rao, On the Emission Spectrum of Acetaldehyde, *III*, 25.
- Rao, C. N. Ramchandra, Absorption of Gases on Glass under Electrical discharge, *III*, 111.
- Rao, C. Venkata, Embryological Studies in Palmae—II, *III*, 231.
- Rao, C. Venkata, Embryological Studies in Palmae—III, *III*, 232.
- Rao, D. V. Raman, K. C. Srinivasa, and S. Pani, Tartarate Complex of Trivalent Antimony—Part I, *III*, 83.

- Rao, B. Ramachandra and F. C. Narasinga Rao, Determination of the true vertical velocity of the E-layer, III, 23.
- Rao, B. Ramachandra and V. Lakshminarayana, Ultrasonic Velocities in solutions of Iodine in Aqueous Solutions of Potassium Iodide, III, 35.
- Rao, D. V. Raman and S. Pani, A Pseudo unimolecular Reaction: Reduction of molybdate by thiosulphate, III, 98.
- Rao, B. Ramachandra and N. V. Gururati. Sarma, Investigation of vertical movements of the F₂ Region of the ionosphere, III, 23.
- Rao, M. R. A., D. P. Kharakar and M. R. A. Rao, Carbides of Titanium, III, 82.
- Rao, S. V. Lakshmi Narayana and C. Ramasastry, Surface Features of Magnetite, III, 183.
- Rao, B. V. Venkata and S. V. Govindarajan, Influence of phosphorus on nitrogen utilisation by Ragi Crop, III, 368.
- Rao, V. Ramakrishna and C. V. Narayana Rao, A peculiar optical transmission property of ordinary glass, III, 40.
- Rao, B. C. Narasinga and B. Ramachandra Rao, Determination of the true vertical velocity of the E-layer, III, 23.
- Rao, V. V., A dielectric lens with a parabolic reflector for Radar Transmitters working on S. and X bands, III, 39.
- Rastogi, R. P., Kinetics of Nucleation in Supercooled Solutions, III, 102.
- Rastogi, R. P. and R. C. Srivastava, Non-equilibrium Thermodynamics of Thermal Transpiration of N₂O₄.
- Rastogi, M. C. and A. C. Chatterji, Distribution of the sparingly Soluble Salts in Banded Structures. Part III, 105.
- Rastogi, R. P. and K. T. Rama Verma, Thermodynamics of solutions of mixed electrolytes, III, 102.
- Rath, R., Attitudes of University students towards some Politico-Economic issues, III, 408.
- Rath, R. and J. P. Das, The factor of understanding in the judgment of literary passages in a Prestigesuggestion experiment, III, 409.
- Ravil, A. A. and N. M. Shah, Studies in Chalkones: Chalkones and related compounds derived from 5-acetamino-2-hydroxy-acetophenone, III, 127.
- Ravikiran, B. R. and Y. M. Dixit, Phosphorus oxychloride as condensing agent for the Pechmann, Reaction: Phenolic esters of coumarin-4-acetic acids, III, 133.
- Ravikiran, B. R. and Y. M. Dixit, BB-Diaryl glutaric acid from phenol, III, 125.
- Rawat, R. R. and R. L. Gupta, Bionomics of Wax-moth *Galleria mellonella* Linn., III, 379.
- Rawat, R. R. and R. L. Gupta, Bionomics of Wax-moth *Galleria mellonella* Linn., III, 379.
- Razdan, M. N., N. N. Das, P. B. Sen and J. N. Mukherjee, A Hypmotic Action of Rauwolfscine, III, 396.
- Ray, H. N. and B. N. Dutta, Effect of Newer Antimalarials on the Morphology of Human Malaria Parasites, III, 332.
- Ray, Gautamsankar, Niren Choudhuri and Arati Sarkar, The Birth and Pregnancy Rites among the Oraons, III, 326.
- Ray, H. N., H. G. Sen and B. N. Dutta, Evidence of Alkaline and Acid phosphatase enzymes in *Trypanosoma evansi*, III, 271.
- Ray, H. N. and B. Dasgupta, A note on the wall of the testis of bed-bug, III, 271.
- Ray, H. N. and B. Dasgupta, Alkaline phosphate activity in the female reproductive tract of bed-bug, III, 271.
- Ray, H. N., H. G. Sen and B. N. Dutta, Antrycide as a trypanocidal drug, III, 336.
- Ray, H. N. and B. Dasgupta, Observations on Rickettsia-like bodies in *Hyalomma savignyi*, III, 287.
- Ray, H. N., B. N. Dutta and H. G. Sen, Effect of Milk diet in *Trypanosoma evansi* infections in rats, III, 335.
- Ray, S. K., S. K. Basu, B. N. Mukherjee and Amitava Basu, A study of the weights of some viscera from 2000 necropsies in Calcutta, III, 327.
- Ray H. N., B. Dasgupta and K. Sengupta, Studies on symbiotes occurring in the mid-gut epithelium of *Ctenolepisma longicauda*, III, 289.
- Ray, H. N. and B. Dasgupta, Occurrence of *Diplocytis* sp. as a parasite in the haemocoel of cockroach, III, 281.
- Ray, H. N., H. G. Sen and B. N. Dutta, Occurrence of Mucopolysaccharides in *Trypanosoma evansi*, III, 272.
- Ray, H. N. and P. C. Sen Gupta, The Cytology of *Balantidium coli*, III, 272.
- Ray, S. and K. Naha, Sylhet Traps—a Local Petrographic study, III, 191.
- Ray, Asit Kumar, Stability of Copper and Nickel Biguanide Complexes, III, 85.
- Ray, Sureshendra Nath and Dulal Pada Sadhu, Histamine and Glycosuria, III, 384.
- Ray, Priyadarshan, J. Xavier and Amiya Kumar Chakraborty, A Critical Review of the Methods for the Colorimetric Estimation of Palladium, III, 76.

- Ray, Priyadarajan, J. Xavier and Amiya Kumar Chakraburty, A Critical Review of the Methods for the Colorimetric Estimation of Titanium, III, 77.
- Ray, P. C., The Manual Ability of the Kanikkars of Travancore, III, 408.
- Ray, Priyadarajan, J. Xavier and Amiya Kumar Chakraburty, A Critical Review of the Methods for the Colorimetric Estimation of Chromium, III, 75.
- Ray, Sureshendra Nath and Dulal Pada Sadhu, Histamine and Glycosuria, III, 384.
- Ray, Asit Kumar, Cis-trans Isomerism of Copper Biguanide Complexes, III, 84.
- Ray, Asit Kumar, Complex Compounds of Biguanide with Bivalent Cobalt, III, 84.
- Raychaudhuri, S., Argentite from the Zawar Mines, Rajasthan, IV, 7.
- Raychaudhuri, S. P., B. V. Subbiah and M. P. Sinha, Comparative value of some rapid soil testing methods for assessing the available status of Nitrogen and Phosphate in Red and Laterite Soils, III, 362.
- Raychaudhuri, S. P., A. B. Ghosh and M. B. Sengupta, Semi-acidulated rock-phosphate (Kotka phosphate) as a phosphatic fertilizer for wheat in calcareous soils, III, 366.
- Raychaudhuri, S. P. and A. B. Ghosh, Fertilizer use of ammonium chloride and ammonium sulphate-nitrate (Leunasalpeter) as sources of nitrogen to paddy and wheat, III, 358.
- Ray Chaudhuri, Tarak Chandra, A Study of Height and Weight of Bengali Girls, III, 320.
- Raychaudhuri, A. and U. P. Basu, Synthesis of 8-aminoquinolines : Part VI, III, 134.
- Ray Chaudhuri, S. and Mihir Bose, On the pelites of the area around Simultala, Bihar, III, 185.
- Ray Chaudhuri, S., Mihir Bose and others, A note on the Geology around Simultala, Bihar, III, 176.
- Reddy, D. V. S., Dhanvantri Mahal of Raja Serfoji of Tanjore. (An Institute for Medico-Historical Studies and Clinical Research in the First Half of 19th Century, III, 341.
- Reddy, D. V. S., The Bibliography of Indo-European Contributions to Tropical Medicine, III, 341.
- Reddy, D. V. S. and Sanjeeva Rao, Effect of pressure variations in Carotid Sinus on Intestinal movements of the adrenaline, Noradrenaline and acetylcholine, IV, 19.
- Rideout, Vincent C., Correlator Study of Nonlinear Systems, IV, 19.
- Rideout, Vincent C., The Methods and Uses of Electronic Analogue Computation, IV, 19.
- Rizvi, S. M. Tahir and Masudul Hasan, The Geographical Background of the Location of Cottage Industries in Uttar Pradesh, IV, 7.
- Rode, K. P., On the Nature of the Talchir Beds of Satpura Coal Fields, III, 181.
- Roichaudhuri, Bhubon Mohan, Anti-thyroid Drugs and Iodide on Mitosis, III, 400.
- Roichaudhuri, Bhubon Mohan, Erythrocyte count of Rats, III, 393.
- Roichaudhuri, Bhubon Mohan, Staining of Thyroid by Masson's Trichrome, III, 404.
- Roichaudhuri, Bhubon Mohan, Cytological changes in Thyroid produced by Anti-thyroid Drugs and Iodide, III, 399.
- Rout, M. K. and H. K. Pujari, N-p-Tolyl Rhodamine and its derivatives, III, 113.
- Rout, M. K., Nabibkishore Das and G. N. Mohapatra, Thiazole Derivatives and their Fungicidal action. Part I-2-substituted-amino 4-5-dimethyl thiazoles, III, 113.
- Rout, M. K. and K. C. Das, Thiodiazolines. Part I-p-tolyl-imino thiodiazoline and its aryl derivatives, III, 113.
- Rout, M. K. and G. N. Mahapatra, Preparation of Thiazolidones and their 5-p-sulphonamido-phenylazo derivatives, III, 123.
- Rout, M. K. and H. K. Pujari, 2-p-chloro-phenyl-imino 4-t thiazolidone and its condensation products and their use as analytical reagents, III, 114.
- Rout, M. K. and G. N. Mahapatra, Some derivatives of 2-arylimino-4-thiazolidones, III, 124.
- Rout, M. K., H. K. Pujari and R. K. Nanda, p-Tolyl-Thiohydantion and its derivatives and their use as analytical reagents, III, 112.
- Rout, M. K. and Bhaskar Das, Studies on Thiazolidones. Part—I. α -Naphthyl-Imino 4-Thiazolidone and its condensation products and use of one of these in the estimation of silver, III, 113.
- Roy, Miss Mira and A. K. Sharma, Plant Chromosomes and Related Cell Structures—their Chemistry, III, 250.
- Roy, R. S., R. K. Singh and M. F. Bari, Effect of Spacing on the Growth and Fruiting of Tomato Var Marglobe Labour, III, 357.
- Roy, Sachin, Distribution of ABO MON Blood Groups and the ABO Secretor Factors among the Tribes of Central and Northern Travancore, III, 320.
- Roy Burman B. K., Need of Research in Tribal Welfare, III, 323.
- Roy, A. C., B. P. Gvani and M. Murari, Oil Tannin from *Caesalpinia Digyna* (Teri), III, 260.

- Roy, Miss Mira and A. K. Sharma, The Scope of Orcein staining in the study of the effect Chemicals on Chromosomes, III, 249.
- Roy, Supriya, On the Manganese ore deposits of Jamda Valley, Keonjhar, III, 205.
- Roy, Supriya and Bankim Mukherjee, Ore-microscopic study of the Lead-Zinc-Silver ore of Zawar Mines, Rajasthan, III, 205.
- Roy, B. B., Vitaminisation of hydrogenated groundnut oil (Vanaspati), III, 169.
- Roy, Supriya, iron ore deposits around Barabil, Keonjhar, III, 207.
- Roy, S. C. and P. R. Pal, A synthetic homologue of pteric acid, III, 142.
- Roy, J. K., A. K. Barua and S. K. Das Gupta, Synthesis of 5, 6, 11, 12-Tetrahydrochrysene, III, 130.
- Roy, J. K. and A. K. Barua, Preparation of suitable intermediate for the synthesis of resin acids: Synthesis of 6-methyl-6-carbomethoxy-acetyl-cyclohexene, III, 129.
- Roy, S. C. and S. Ganguly, Amino acid composition of the mycelia of *Streptomyces griseus* formed during its production of vitamin B₁₂, III, 146.
- Roy, D. K. and A. Sengupta, Stability of Vitamin A in Shark-liver oil emulsions, III, 143.
- Roy, S. C. and N. C. Ganguly, Concentration of some B-vitamins in the Liver Tissue of Rats under Chloretone, III, 146.
- Roy, S. C. and N. C. Ganguli, Amino Acid Composition of different tissues of rat under chloretone, III, 142.
- Roy, J. K., D. Chakravarti, and A. K. Barua, On the Constitution of Entagenic Acid, a new triterpenoid isolated from the seeds of *Entada pursaetha* DC, III, 129.
- Roy, P. M., Difference theorems for the construction of Group Divisible Designs, III, 18.
- Roy, R. P., An additional evidence for the presence of the genome of *Aegilops squarrosa* in the hexaploid wheats, III, 246.
- Roy, P. M., Difference Theorem for the Construction of Hierarchical Group Divisible Incomplete Block Designs, III, 1.
- Roy, A. N. and A. R. Ghosh, Influence of Foaming agent on the Velocity of Reduction of Haematite with Hydrogen, III, 91.
- Roy, J., Quality control by gauging, III, 21.
- Roy, P., Study on dispersion of clay with different chemical reagents, III, 420.
- Roy, A. N. and Parimal Sen, Studies on the Nature and Distribution of Mineral Matter in Indian Coals, III, 427.
- Roy, R. N. and N. N. Das, Effect of Extract of *Symplocos* CCortex (Bengali Lodhi) on the Toad's Heart, III, 398.
- Roy, P. M., On some simple properties of semi-regular Group Divisible Designs, III, 19.
- Roy, N. K. and A. N. Bose, Milk in Treatment of Malaria, III, 332.
- Roy, B. B., Comparison of blended and straight-hardened hydrogenated groundnut oils (Vanaspati) regarding their keeping quality, III, 170.
- Roy Choudhury, K. and Sunil Kumar Mukherjee, Floral Biology in Mango, III, 370.
- Roy Chowdhury, S. P. and S. B. Lal, Total and "Available iron" in some foods, III, 340.
- Roy Choudhury, R. C. Basu, D. Ganguly and M. N. Goswami, Studies on the Nutritive value of Synthetic Glycerides, III, 144.
- Roy, Choudhury, N. K., D. Venkateswarlu and S. V. L. N. Rao, Extractives of South Arcot Lignites, III, 166.
- Roy Choudhury, R. Basu, D. Ganguly, Samir Sarkar and M. N. Goswami, Studies on the preparation of Monoglycerides: Direct esterification of fatty acids and glycerol, III, 124.
- Roy Choudhury, R. C. Basu, S. Sarkar, D. Ganguly and M. N. Goswami, Purification of Technical Monoglycerides, III, 164.
- Roy Choudhury, R. Basu, D. Ganguly and M. N. Goswami, Investigations on Reclamation of Rancid Food Fats, III, 165.
- Roy Choudhury, N. K. and S. K. Nandi, Solvent Extraction of Cotton Seed Oil, III, 161.
- Rudra, M. N., Biogenesis of Ascorbic Acid, III, 146.
- Rudra, M. N., Vitamin C Metabolism, III, 386.

S

- Sach, M. J. and S. R. Patel, Studies in Friedel-Craft's Reaction: Friedel-Craft's Acetylation of Aceto o-Toluidide, III, 127.
- Sach, M. J. and S. R. Patel, Synthesis of 5-methyl-acridine derivatives, III, 127.
- Sachar, R. C. and R. N. Chopra, Experiments on induced Parthenocarpy in some plants, III, 267.

- Sachar, R. C., P. Maheshwari and R. N. Chopra, Embryological Studies in Mango (*Mangifera indica* L.), III, 233.
- Sadhu, D. P. and S. P. Bhatnagar, Measurement of Surface Area in Goats, III, 347.
- Sadhu, Dulal Pada and Sureshendra Nath Ray, Histamine and Glycosuria, III, 384.
- Sadhu, D. P. and S. B. Choudhury, Bio-Chemical studies in the blood of normal goats of Jamnapuri breed, III, 347.
- Sadhu, D. P. and Sailen Mookerjee, A method of the determination of free Total Cholesterol in blood and tissues, III, 403.
- Sadhu, D. P. and S. P. Bhatnagar, Comparative studies on Ionic Exchange in stretched and unstretched muscle, III, 389.
- Sadhu, Dulal Pada and Sureshendra Nath Ray, Histamine and Glycosuria, III, 384.
- Sadhu, D. P. and N. K. Das, Haematological Studies on Indian Goats, III, 347.
- Sah, H. P. and B. Sen, Estimation of Amino Acids in control and vernalised Seedlings of Mustard T. 102, III, 264.
- Sahai, K., I. Kumar and N. D. Kehar, Rape (*Brassica napus* Linn), bhoosa as food for cattle, III, 365.
- Sahni, M. R., Bio-geological Evidence bearing on the Destruction of the Indus Valley Civilisation, IV, 12.
- Sahani, V. M. and Nirad K. Sen, Naturally occurring Triploid, Tetraploid and Pentaploid Lantana camara, III, 247.
- Saha, R. K., H. N. Chatterjee, K. K. Chatterjee, D. K. Ghosh and H. Ghosh, A Study of Pyrexia and some febrile and other Inflammatory Complications of Cholera, III, 332.
- Saha, Ajit Kumar, The Metasomatic Diorities of Eastern Singhbhum, III, 192.
- Saha, A. N. and Balraj Ajmani, Studies in Wrinkle Finishes. Part I, III, 148.
- Saha, A. N. and Nripendra Chandra Saha, Utilization of Andaman Resin, III, 163.
- Saha, Nripendra Chandra and A. N. Saha, Utilization of Andaman Resin, III, 163.
- Saha, Ajit Kumar Deformation-Lamellae in Quartz from Granophytic Granite and Diorite of Butgora-Sarjori area, Eastern Singhbhum, III, 184.
- Sahasrabudhe, N. B., N. S. Ranadive and K. S. Korgaonkar, Chemical effects of ionizing radiations on solutions of Nucleic Acid, Purine and Pyrimidine bases by Spectroscopic Method, III, 147.
- Sahu, K. C., Clinical Observations on the Use of Calciferol (Vitamin D₂) in Psoriasis, III, 334.
- Sahu, V. K. and M. C. Nath, Occurrence of Glucose in combination with Acetoacetate in normal urine, III, 386.
- Saikia, A., G. C. Goswami and P. C. Goswami, Influence of Inorganic Salts on the RF Values of Amino Acids, IV, 6.
- Saletore, S. A. and N. Bhojraj Naidu, A Modified Laboratory set up for Alkyd Preparation, III, 172.
- Saletore, S. A. and S. S. Joshi, Fuller's earths from Hyderabad State, their occurrence and Bleaching Properties, III, 155.
- Saletore, S. A. and N. Bhojraj Naidu, Preparation of Castor-modified Alkyds by "The Drying Alkyds Castor Process": Part I, III, 168.
- Saletore, S. A. and N. Bhojraj Naidu, Preparation of Castor Modified Alkyds by 'the Monoglyceride Method' using without catalysts and azeotropic solvent xylol. Part II, 131.
- Saletore, S. A. and N. Bhojraj Naidu, Preparation of Castor Modified Alkyds by the "Monoglyceride method" using the catalysts and azeotropic Solvent Xylol. Part III, 132.
- Saletore, S. A. and V. R. Harwalkar, Studies on storage of Indian Cottonseed and oil: Part I, III, 132.
- Samantora, K. C., D. V. Raman and S. Pani, Tartarate Complex of Trivalent Antimony—Part I, III, 83.
- Samantarai, B. and T. Kabi, Cambial activation and secondary growth in petioles of the rooted leaves, III, 266.
- Samantarai, B. and S. K. Sinha, Factors which influence the rooting response of isolated leaves of *Ipomoea batatas*, Lamk, III, 266.
- Samantarai, B. and G. Misra, Effect of spraying B-indolyl acetic acid solution on the growth and reproduction of rice plants, III, 266.
- Samantari, B. and S. K. Sinha, The range of variation in the number of Protoxylem Poles in the adventitious roots of a few Dicot plants, III, 238.
- Samantarai, B. and A. S. Dubey, Induction of Drought Resistance in Rice Plants, III, 258.
- Samantarai, B. and S. K. Sinha, Induction of roots with higher number of protoxylem poles in Dicot seedlings, III, 257.
- Samantari, B. and T. Kabi, Effect of feeding on the rooting response of isolated leaves of *Ipomoea batatas*, III, 257.
- Samantari B. and G. Misra, Effect of various levels of Nitrogen on the vegetative growth and ear emergence of rice plants, III, 257.

- Samantarai, B. and D. N. Mohanty, Changes in titratable acidity in isolated leaves during the period of root emergence following hormone treatment, III, 258.
- Samantari, B. and H. Pattnaik, Rooting response of the Twings of *Aristoechia Giagas*, Lindl, III, 257.
- Sane, C. K. and S. V. Chakdrashékhar Aiya, Atmospheric Noise level in the 10 Mc/s Bank at Poona, III, 422.
- Sankaran, C. K., P. C. Ganesnsundaram and B. Chaitanya Deva, Reversed Speech and the Alpha-phoneme Theory, IV, 18.
- Sanyal, P., B. C. Kundu and A. N. Datta, Comparative Study of the Yield Performances on the Different Fibre Crops, III, 355.
- Sanyal, P., A. N. Datta and B. C. Kundu, Preliminary Studies on the Effect of Different Dates of Sowing in Mesta and Roselle, III, 258.
- Sanyal, S. N., P. C. Sinha and K. K. Chatterjee, Hydrolysis of Phosphorous Trichloride and Preparation of Phosphorous Tetratoxide, III, 85.
- Saraf, V. A. and K. K. Dole, Dehydration of Castor Oil with Phenol Trisulphonic Acid as Catalyst, III, 154.
- Saraf, J. R. and K. N. Vaish, pH determination of Iodic acid solutions, III, 36.
- Sarma, N. V. Gurunatha and B. Ramachandra Rao, Investigation of vertical movements of the F₂ Region of the ionosphere, II, 23.
- Sarkar, S. N. Correlation of analysis of soils by standard sieves and sedimentation, III, 149.
- Sarkar, Satya Ranjan, Bacteriological Study of Toned Milk, III, 401.
- Sarkar, B. B. Ajit Maiti and Hrishikesh Jana, Effect of Kukscine on the Haematological studies of rabbits, III, 396.
- Sarkar, B. B. and Ajit Maiti, Studies on the action of Kukscine—the active principle isolated from the *Vernonia cinerea* (less) on the Tracheal chain and Lung perfusion, III, 392.
- Sarkar, B. B., Ajit Maiti and Bhupendra Nath Chauddhuri, Effect of Kukscine—the active principle of *Vernonia cinerea* (less) on the clotting activity of blood, III, 393.
- Sarkar, N. K., R. Ghosh and S. R. Maitra, Existence of a Cardio-stimulating Factor in Cobra Venom, III, 391.
- Sarkar, Satya Ranjan, Cleaning and Sterilisation of Dairy Plants, III, 342.
- Sarkar, Arati, Niren Gautamsankar and Niren Choudhuri, The Birth and Pregnancy Rites among the Oraons, III, 326.
- Sarkar, S. S., Usha Deka and K. K. Agarwal, Brachycephaly in India, III, 319.
- Sarkar, H. L., The composition of Hilsa ilisha (Ham) catch in the Lower Sundarbans area during the winter months, III, 305.
- Sarkar, S. K. and A. K. Sharma, Veratrine—Its use in Cytochemistry, III, 251.
- Sarkar, S. K., Application of New Technique to the Cytogenetical Investigation of Plams, III, 252.
- Sarkar, S. N., Basification and Granitisation of the Metaandesites and the Associated Sedimentary Quartzites of Dongargarh Tahsil, Drug District, Madhya Pradesh, III, 196.
- Sarkar, Samir, R. Basu Roy Choudhury, M. N. Goswami and Samir Sarkar, Studies on the preparation of Monoglycerides: Direct esterification of fatty acids and glycerol, III, 124.
- Sarkar, S., R. CC. Basu Roy Choudhury, D. Ganguly and M. N. Goswami, Purification of Technical Monoglycerides, III, 164.
- Sarkar, Satya Ranjan, Bacteriological Study of cow milk, III, 401.
- Sarup, Shanti and Brijmohan, Habits of Weeds of Jawant College Compounds, Jodhpur, III, 241.
- Sarup, Shanti and S. K. Tondon, Root System of *Gynandropsis pentaphylla* DC, III, 241.
- Sastri, R. L. N., The Embryology of *Ceratophyllum Demursum* L., III, 226.
- Sastri, R. L. N., Studies in Lauraceae—II, III, 225.
- Sastri, M. V. C., J. C. Ghosh and T. S. Viswanathan, Reaction in the substrate formed on a Cobalt Fischer-Tropsch catalyst, III, 104.
- Sastri, M. L. N., The Near Ultraviolet Absorption Spectrum of 1, 3, 5-Trifluorobenzene Vapour, III, 25.
- Sastry, N. S. N., Measurement of Social Distances in Society and Industry, III, 408.
- Sastry, M. Srinivasa and P. N. Bhargava, Studies on 3-p-tolyl-2:4-thiazolidione, III, 123.
- Sastry, N. S. N., An aspect of the Problem of Perception, III, 406.
- Sawhney, P. C., Blook Studies in Relation to Neck Molting in Poultry, III, 343.
- Sawhney, P. C., Carotene Content of Common Poultry Feeds, III, 343.
- Saxena, D. B. and S. M. Das, On intermediate stages in evolution of afferent arches from fishes to amphibia, IV, 11.
- Saxena, S. C. and B. N. Srivastava, Semi-empirical formulae for the Thermal diffusion factor of mixtures with one invariable constituent, III, 36.

- Science and its Social Relations, IV, 136.
- Sen, P. B., N. N. Das, J. N. Mukherjee and M. N. Razdan, A Hypmotic Action of Rauwolscine, III, 396.
- Sen, P. B. and J. N. Mukherjee, Comparative Studies of Rauwolscine with Yohimbine on the Blood Pressure and Respiration, III, 396.
- Sen, P. B., The effect of different levels of Protein intake on the Ascorbic Acid requirement, III, 386.
- Sen, P. B., Amal Kumar Biswas and J. N. Mukherjee, Effect of Rauwolscine on the Cholesterol and Ascobic Acid Content of Adrenal Gland, III, 396.
- Sen, P. B., J. N. Mukherjee and Amal Kumar Biswas, A new Anti-histaminic Substance, III, 394.
- Sen, P. B. and J. N. Mukherjee, Site of Hypotensive Action of Rauwolscine Hydrochloride, III, 393.
- Sen, P. B. and J. N. Mukherjee, Determination of Toxicity and Therapeutic dose of Rauwolscine, III, 394.
- Sen, P. B. and J. N. Mukherjee, Effect of Rauwolscine Hydrochloride on the Voluntary Muscles, III, 389.
- Sen, P. B., J. N. Mukherjee and N. N. Das, Effect of Rauwolscine on the central nervous system, III, 395.
- Sen, A. and J. C. Banerjee, Clinical Evaluation of Certain Antibiotics in the Treatment of Diphtheria, III, 334.
- Sen, B. and H. P. Sahi, Estimation of Amino Acids in control and vernalised Seedlings of Mustard T. 102, III, 264.
- Sen, H. G., H. N. Ray and B. N. Dutta, Occurrence of Mucopolysaccharides in *Trypanosoma evansi*, III, 272.
- Sen, H. G., H. N. Ray and B. N. Dutta, Evidence of Alkaline and Acid phosphatase enzymes in *Trypanosoma evansi*, III, 271.
- Sen, K. and D. Mukherji, Cephalic morphology, mouth parts and the anatomy of Silver fish, *Ctenolepisma longicaudata* Esch (Thysanura), III, 290.
- Sen, H. G., B. N. Dutta and H. N. Ray, Effect of Milk diet in *Trypanosoma evansi* infections in rats, III, 335.
- Sen, Nirad K. and Subir Sen, Meiotic Abnormalities and Chromosome number in *Bougainvillea*, III, 247.
- Sen, Nirad K. and A. K. Ghosh, Study on Karyotype of Common Pulses, III, 247.
- Sen, Subir and Nirad K. Sen, Meiotic Abnormalities and Chromosome number in *Bougainvillea*, III, 247.
- Sen, H. G., H. N. Ray and B. N. Dutta, Antrycide as a trypanocidal drug, III, 336.
- Sen, B. and D. K. Verma, Estimation of Hmino-acids in the Vernalisable and Non-Vernalisable Strains of Wheat, III, 263.
- Sen, B. and Gyanendra Verma, Effect of Presoaking Chilling Seeds of Mustard T 102, and Wheat Pb. 228 in Different Inorganic Media, III, 262.
- Sen, B. and Gynendra Verma, Studies on the Pollen Grains of Crop Plants—Mustard (*Brassica campestris* var. Yellow Sarson Prain.) and Garden Pea (*Pisum sativum* L.), III, 262.
- Sen, B. and Gyanendra Verma, Studies on the Pollen Grains of Crop Plants—Maize (*Zea Mays*) II. Effect of Ovule and Silk Extracts, Calcium Nitrate and Phenoxy Compounds on the Elongation of Pollen Tubes, III, 261.
- Sen, B. and H. C. Joshi, Premeability of the Plasma Membrane of Leaf Cells of rust resistant and Susceptible Varieties of Wheat, III, 263.
- Sen, Nirad K. and S. K. Majumder, Enrichment of Soil Plate for the Isolation of Specific Organisma, III, 219.
- Sen, Milan Kumar, Sedimentary Structures in the Panchet Stage, S.E. of Raniganj Basin, III, 197.
- Sen, P. and Amal Bhusan Mukherjee, Preliminary note on the life history of *Amsacta lactineus* (Gram), a pest of groundnut (*Arachis hypogea*), III, 291.
- Sen, Milan Kumar, Petrology of the Agrillaceous and Arenaceous Metamorphites,, near Mejia, Bankura District, West Bengal, III, 198.
- Sen, Nirad K. and V. M. Sahani, Naturally occurring Triploid, Tetraploid and Pentaploid *Lantana camara*, III, 247.
- Sen, Milan Kumar, On the Calc-Magnesian Metamorphites and related Amphibolites around Kusthalia, Bankura District, West Bengal, III, 199.
- Sen, Binayendra Nath, Utility Plastic from liquid refuse, Feina (gruel) after cooking of rice and Refuse of Tea-leaves and Tea-dusts after decoction for the liquor in preparing tea, III, 148.
- Sen, G. P., S. B. Ghosh and P. Nandi, Studies on counter-current distribution and applications, Part II, 110.
- Sen, R. N., On a generalisation of a 3-dimensional space of Constant Curvature and of Clifford's parallelisms, III, 7.
- Sen, Binayendra Nath, On Thermoionic Potential A Physico-chemical Theory of Thermonic Effect on the basis of parachoric strain, III, 88.

- Sen, D. K. and B. N. Ghosh, The Evaluation of Rate Constants of First-Order irreversible Reactions with the Help of Alignment Chart—Part I, III, 94.
- Sen, U. K., A study on the prediction of success in engineering courses, III, 21.
- Sen, K. K., On the problem of softening and polarisability of radiation in an electron atmosphere, scattering according to Rayleigh's Law and involving multiple Compton scattering, III, 38.
- Sen, Binayendra Nath, On the Separation of Inorganic Anions by Chalk Crayon Chromatography, III, 77.
- Sen, S. N., Estimation of soil heterogeneity in jute trials, III, 21.
- Sen, Saurin and Bankim Mukherjee, Note on the occurrence of Magnetite bearing Quartzites near Ramchandrapur, P. Manbhum, III, 187.
- Sen, N. K., A Chakrabarty, S. R. Chakrabarty and M. M. Chakrabarty, Studies on Jute Seed Oils, III, 157.
- Sen, Milan Kumar, Association of Carbonaceous Material with red clay bed in Panchet Stage, South East of Raniganj Basin, III, 180.
- Sen, P. B. and A. K. Chowdhury, Effect of Infra-red irradiation of spermatogenesis of guineapigs, III, 402.
- Sen, S. M. and R. B. Joshi, Study of a Non-Linear Magnetic Circuit, III, 425.
- Sen, Parimal and A. N. Roy, Studies on the Nature and Distribution of Mineral Matter in Indian Coals, III, 427.
- Sen Gupta, P. N., Nutrition Problems of the Tribes of Abor hills (Assam), III, 386.
- Sengupta, M. B., A. B. Ghosh and S. P. Raychaudhuri, Semi-acidulated rock-phosphate (Kotka phosphate) as a phosphatic fertilizer for wheat in calcareous soils, III, 366.
- Sengupta, M. B., M. A. Idnani, A. B. Ghosh and R. K. Chibber, Fertilizer value of Dicalcium phosphate in non-acid calcareous soils of India, III, 364.
- Sengupta, K., B. Dasgupta and H. N. Ray, Studies on symbiotes occurring in the mid-gut epithelium of *Ctenolepisma longicaudata*, III, 289.
- Sen Gupta, P. C. and H. N. Ray, The Cytology of *Balantidium coli*, III, 272.
- Sen Gupta, Anupam, S. R. Chakrabarty and M. M. Chakrabarty, The seed fat composits of Albizzi Lebhek, III, 152.
- Sen Gupta, M. L. and U. P. Basu, On the Effect of Bleaching of Arachis Oil, III, 169.
- Sengupta, A. and D. K. Roy, Stability of Vitamin A in Shark-liver oil emulsions, III, 143.
- Sengupta, Ranjit, Intermolecular Potential in a Molecular Assembly, III, 109.
- Sen Gupta, A. M., Stress distribution around circular holes in cylindrically aeolotropic plates, III, 9.
- Sengupta, N. D., On the classical theory of the motion of charged particles and the electromagnetic-field, III, 38.
- Sen Gupta, P. N., Studies the vital capacity of Nocte Naga of Tirap Frontier Division (N.E.F.A.), III, 320.
- Seshachar, B. R. and Miss P. B. Padmavati, Origin of Micronuclei in *Spirostomum ambiguum* P., III, 269.
- Seth, B. R., Stability of Rectilinear Plates, III, 9.
- Sethna, Suresh, S. S. Lele and N. H. Shah, Studies in Hydroxyanthracene derivatives. Part I, reactions of 1-anthrol, III, 115.
- Sethna, Suresh and N. J. Desai, Synthesis of 4-hydroxycoumarin derivatives, III, 115.
- Sethna, Suresh and Miss Sindhu Parkhi, Synthesis of some 2-methyl chromone and flavone carboxylic acids, III, 115.
- Shah, N. L., Alcoholic Clove Oil Method for simultaneous Dehydration and Clearing, III, 318.
- Shah, C. C. and J. V. Amin, Manganese Status of Soils of Western India—II Content of Manganese in Plant Leaves, III, 365.
- Shah, C. C. and J. V. Amin, Manganese Status of Soils of Western India—I, III, 364.
- Shah, C. C. and B. V. Mehta, Accumulation and Movement of Minerals in Bajri (*Pennisetum typhoideum*), III, 373.
- Shah, C. C. and N. M. Parikh, Mineral Nutrition of Common Crops of Gujarat, Effect of Manganese Part III. Absorption of Iron I, II, 376.
- Shah, C. C. and N. M. Parikh, Mineral Nutrition of Common Crops of Gujarat. Effect of Manganese Part II. Absorption of Calcium, Manganese, Phosphorus and Nitrogen, III, 377.
- Shah, C. C. and B. V. Mehta, Effect of Different Levels of Plant Potassium on the Uptake of Cations by Bajri (*Pennisetum typhoideum*), III, 374.
- Shah, J. J. and A. R. Chavan, Origin and development of the vegetative axillary bud in *Vitis repens* W. & A., III, 225.

- Shah, N. M. and M. R. Bhat, Studies in Fries Migration. The Fries Isomerisation of acyl esters of ortho and para-hydroxy-acetophenones and para-hydroxy-benzophenone, III, 128.
- Shah, N. M. and A. A. Raval, Studies in Chalkones: Chalkones and related compounds derived from 5-acetamino-2-hydroxy-acetophenone, III, 127.
- Shah, N. M., G. S. Mewada and S. R. Patel, Synthesis of 2:8-dimethyl-3-substituted-4-quinazolones, III, 126.
- Shah, N. M. and G. S. Mewada, Nitration of 6-hydroxy-4-methyl coumarin and its methyl ether, III, 127.
- Shah, N. M. and M. R. Bhat, Coumarins derived from p-alkyl-phenols, III, 126.
- Shah, N. H., S. S. Lele and Suresh Sethna, Studies in Hydroxyanthracene derivatives Part I, reactions of 1-anthrol, III, 115.
- Shah, S. M., Exceptional values B and E of Meromorphic functions of infinite order, III, 5.
- Shaikh, M. A., P. S. Javadekar and V. A. Patwarddan, Non-fatty Matter from the seeds of (i) *Ocimum basilicum*, Linn., and (ii) *Ocimum canum*, Sims, III, 171.
- Shanker, Uday, Juvenile Crime and Intelligence, III, 409.
- Shenolikar, I. S. and K. S. Nargund, Condensation of Glycol mono-ethers of Phenol and Cresols with Succinicanhydride, III, 116.
- Sharma, V. N. and R. B. Arora, Pharmacological investigations of Di (B-O-Methoxyphenyl-isopropyl)-amine lactate (U-0069 code name): A new local anaesthetic, III, 338.
- Sharma, Ram Avatar and R. M. Kasliwal, Significance of Sodium Clearance test in Cases of Ascites due to Cirrhosis of Liver, III, 339.
- Sharma, V. N., R. B. Arora and B. N. Consul, "Clinical Trial of 'P-267' in Ophthalmic Surgery", III, 337.
- Sharma, A. K. and S. Mukherji, The Male Genitalia of the Desert Locust *Schistocerca gregaria* (Forsk.) (Acrididae: Orthoptera), III, 295.
- Sharma, G. P. and G. S. Sud, Spermatogenesis of *Lygeus militaris*, III, 275.
- Sharma, G. P. and Ram Parshad, Structure and behaviour of the chromosomes in the wild population of *Halys dentatus* (Hemiptera-Heteroptera), III, 275.
- Sharma, G. P. and K. K. Nayar, A Study of the Cytoplasmic Inclusions during the Spermatogenesis of the Domestic fowl, *Gallus domesticus*, III, 274.
- Sharma, G. P. and K. S. Dhindsa, Spermatogenesis of the Toad (*Bufo stomaticus*—"Lutkin") with particular reference to the Cytoplasmic inclusions, III, 274.
- Sharma, A. K. and Miss Mira Roy, Plant Chromosomes and Related Cell Structures—their Chemistry, III, 250.
- Sharma, A. K. and Ramen Mukherji, Effect of Irradiation on Embryonic Cells, III, 250.
- Sharma, A. K. and S. K. Sarkar, Veratrine—Its use in Cytochemistry, III, 251.
- Sharma, A. K. and Miss Bibha Bhattacharyya, Vitamins—their Property of Inducing Chromosome Division in Permanent Cells, III, 251.
- Sharma, A. K. and Arunabha Dutta, Induction of Chromosome Division through Ascorbic Acid Treatment, III, 249.
- Sharma, A. K. and Miss Mira Roy, The Scope of Orcein staining in the study of the effect of Chemicals on Chromosomes, III, 249.
- Sharma, A. K. and Deepesh De, Polyploidy in *Dioscorea*, III, 248.
- Sharma, A. K. and Deenesh De, Heterocyclic bases—an aspect of their use in Cytochemistry, III, 248.
- Sharma, R. S., A. G. Jhingran, S. M. Mathur and S. N. Puri, A Study of the Bundelkhand Granite in Chhatarpur District, Vindhya Pradesh, III, 195.
- Sharma, G. S., Hydroxy Ketones. Part IV, III, 126.
- Sharma, R. K. and N. G. Nagar, Study of the visceral fat of 'Kan' Mushi, III, 145.
- Sharma, N. N. and R. C. Mehrotra, Oxidation of Citric Acid by Ceric Sulphate, III, 106.
- Sharma, N. N. and R. C. Mehrotra, Oxidation of Phenolic compounds with Ceric Sulphate, III, 107.
- Sharma, N. N. and R. C. Mehrotra, Oxidation of Glycerol with Ceric Sulphate, III, 106.
- Sharma, P. N., S. N. Dutta and S. R. Bhattacharya, Study of Electrolytic Dissociation by X-Ray diffraction—II, III, 35.
- Sharma, T. R., Om Prakash and Amanullah Khan, Preparation of Activated Carbons from the waste materials of the oil Industry viz. the Shell (Husks) of Neem, Castor and Mahua Seeds, III, 161.
- Sharma, T. R., Om Prakash and Amanullah Khan, A Study of the Forest Oilseeds: *Albizia labbek* and *Albizia procera* and their Oils. Part I, III, 162.
- Shingre, M. V., D. D. Desai and N. R. Tawde, Transition Probabilities in bands of Blue-green system of TiO by numerical integration methods of Bates and Pillows, IV, 5.

- Shome, S. C. and A. K. Chaudhury, Inhibition of Corrosion of Steel by Pigments, III, 172.
- Shrikhande, S. S., Wald's two moments problem, III, 14.
- Shukla, K. P. and C. M. Pant, Staunching of Canals, III, 417.
- Shukla, K. P. and C. M. Pant, Electro-Chemical Treatment of Clays. Part III, III, 96.
- Shukla, K. P. and R. P. Srivastava, Stabilized Soil Blocks for the Protection of Clay Bank against Wave Action, III, 417.
- Siddhanta, Sushil Kumar and Satyendra Nath Banerjee, The Dissociation of Cobalt Acetate in Aqueous Solution, III, 104.
- Sidhu, G. S. and S. Husain Zaheer, Addition of Iodine 3, 5-dinitrobenzoate to Terpenes, III, 133.
- Sidhu, G. S. and S. Husain Zaheer, Action of metal cyanides on 1-methyl-4-bromo-4-phenylpiperidine hydrobromide, III, 131.
- Siddique, Md. Mahfooz Ali, A Rectangular plate bent into a Right Cylindrical Surface, III, 10.
- Singhal, B. V., On the equations of the structure for the projective and conformal geometry, IV, 1.
- Singh, R., K. K. Jha, A. S. Varma and H. N. Mukherjee, Studies on Ammonification and Nitrification in Bihar soils in relation to soil conditions, III, 367.
- Singh, S. K. and R. Prashad, Some Diode-gating Techniques for Obtaining Decade Scaling from Binary Scalars, III, 427.
- Singh, R. K., R. S. Roy and M. F. Bari, Effect of Spacing on the Growth and Fruiting of Tomato Var Marglobe Labour, III, 357.
- Sing, K. Kripal, P. B. Mathur and H. C. Srivastava, Studies on the Cold Storage of Mangosteen (*Garcinia mangostana*), III, 378.
- Singh, T. C. N. and Miss Stella Ponniah, On the response of structure of the leaves of Balsam and Mimosa to the Musical sounds of Violin, III, 254.
- Singh, K. Kripal and P. B. Mathur, Cold Storage of Grapes, III, 374.
- Singh, T. C. N., On the Vernalization of the cuttings of Sweet-potato, III, 256.
- Singh, T. C. N., On the effect of moonlight on the growth of *Petunia hybrida* Linn., III, 254.
- Singh, R. L., Urban Hierarchy in the Umland of Banaras, III, 214.
- Singh, R. L., Mirzapur: A Study in Urban Geography, III, 215.
- Singh, Krishna Kant, On the Archaean formations of Ambikapur, Surguja District, M.P., 199.
- Singh, Taralochan and M. H. Desai, Attempts for the Manufacture of Ultramarine blue, III, 173.
- Singh, Baldev and S. Husain Zaheer, Condensation of s-dichloroacetone with phenol and its ethers, III, 133.
- Singh, Y. P. and M. R. Verma, Estimation of Arsenic or Antimony in presence of Copper, III, 80.
- Singh, P. P. and C. S. Marwani, Interaction of Histidine with Sugars in aqueous Solutions studied potentiometrically. Part I: Glucose, III, 101.
- Singh, D. and P. G. Menon, Conductometric Estimation of Thrium and Cerium, III, 103.
- Singh, D. and P. G. Menon, Variation of the Sulphide Concentration of Aqueous Hydrogen Sulphate Solutions with Time, III, 103.
- Singh, Rama Sankar, The Absorption Spectrum of Benzoquinone, III, 27.
- Singh, D. and P. G. Menon, Potentiometric Estimation of Sulphide, III, 103.
- Singh, Krishna Kant, A Study of the Archaean formations in the vicinity of Girar, Jhansi District (U.P.) III, 179.
- Singh, S. N. On the Laki Formations near Khewansar (Rajasthan), III, 182.
- Sinha, Durganand and Kailash Chandra Prasad, A study of Job Stisfaction in Office and Manual Workers, III, 412.
- Sinha, M. P., S. P. Raychaudhuri and B. V. Subbiah, Comparative value of some rapid soil te itsgnmethods for assessing the available status of Nitrogen and Phosphate in Red and Laterite Soils, III, 362.
- Sinha, S. K. and B. Samantarai, Factors which influence the rooting response of isolated leaves of *Ipomoea batatas*, Lamk, III, 266.
- Sinha, S. K. and B. Samantarai, The range of variation in the number of Protoxylem Poles in the adventitious roots of a few Dicot plants, III, 238.
- Sinha, S. K. and B. Samantarai, Induction of roots with higher number of protoxylem poles in Dicot seedlings, III, 257.
- Sinha, The Vegetation of Glacial Moraines of the Pindari Glacier, Kumaun, India, III, 242.
- Sinha, Arun Kumar and M. Q. Doja, Synthesis of cyanine dyes by the condensation of p dialkylaminobenzaldehyde with appropriate heterocyclic compounds. Part VI, III, 119.

- Sinha, S. R., On the non-summability of the conjugate series of a Fourier series, III, 3.
- Sinha, P. C., K. K. Chatterjee and S. N. Sanyal, Hydrolysis of Phosphorous Trichloride and Preparation of Phosphorous Tetritoxide, III, 85.
- Sinha, P. C. and G. C. Bhattacharya, Pressure—Composition Isothermals of the Systems: Zinc Sulpha-a Picoline-Water and Cadmium Sulphate-a-Picoline-Water at 60°C, III, 105.
- Sircar, P. K., Probability of High Floods in the Rupnarayan, The Kansai and the Subarnarekha, III, 209.
- Som, K. C., A. K. Lahiri and G. P. Chatterjee, Vibration Damping Characteristics of some Typical Metals and Alloys, III, 431.
- Som, K. C. and G. P. Chatterjee, X-ray diffraction studies of Carbon Steel samples super-saturated with hydrogen, III, 428.
- Sonar, V. C. and V. A. Patwardhan, Fatty Oil and Non-Fatty matter from the seeds of *Thespesia populnea*, Linn., III, 167.
- Soota, T. D., Fauna of the Kashmir Valley: Leeches, IV, 10.
- Soundarajan, Sundaresa and K. R. Krishnaswami, The Dipole moment and molecular structure of quinone oximes, III, 98.
- Sreenivas, A. and Jogarao, Utilisation of South Arcot Lignite for the Production of Calcium Carbide, IV, 6.
- Sreenivasan, A. and R. Venkataraman, Bacteriology of Off-shore Marine Environments (Pearl Banks) off Tuticorin, III, 314.
- Sreenivasan, A. and R. Venkataraman, Utilisation of Various Nitrogenous Compounds by certain *Pseudomonas* Cultures from Marine Environments, III, 314.
- Srinivasan, R. and R. Ganesan, Effluents from the Prode Cauvery Textiles Limited, Bhavani and their effect on the fisheries of the Cauvery river, III, 305.
- Sreenivasan, A. and R. Venkataraman, Spoilage of Commercially Canned Fish, III, 306.
- Srinivasan, R. and P. I. Chacko, Further experiments on the control of aquatic vegetation with '2,4-D', III, 317.
- Sreenivasan, A., R. Venkataraman and A. G. Vasavan, Drying of Fish with Infra-red Lamps, III, 306.
- Sreenivasan, A. and R. Venkataraman, Effect of Sewage Effluents and the Coliforms on Sea water, III, 313.
- Srinivasan, C., On the occurrence of "gemae" in *Mnium* sp., III, 222.
- Srinivasan, T. P., On p-variations of Functions, IV, 1.
- Srinivasan, T. R., Spells of abnormally hot and cold days during the hot weather period April-May and winter December-January respectively at Poona, III, 20.
- Srinivasachar, H. R., Observations on the Development of the Chondrocranium in *Vipera*, III, 277.
- Srivastava, J. P. and S. S. Banerjee, Predicted and observed critical frequencies for F₂ region of the ionosphere, III, 422.
- Sreenivasan P. S. and P. S. Nayer, The Physical Significance of the Growth constants of the Skew Logistic Elongation Curve of Sugarcane Crop, IV, 2.
- Srivastava, R. P. and K. P. Shukla, Stabilized Sil Blocks for the Protection of Clay Bank against Wage Action, III, 417.
- Srivastava, H. C. and P. B. Mathur, Cold Storage of Field Beans (*Dolichos lablab*), III, 374.
- Srivastava, H. C., Effect of the Cultural Factors on Incidence of Damping-off Disease in the Nursery Beds, III, 378.
- Srivastava, H. C., Effect of the Cultural Factors on Incidence of Damping-off Disease in the Nursery Beds, III, 378.
- Srivastava, H. C. and P. B. Mathur, Studies in the Cold Storage of Langsats, III, 378.
- Srivastava, H. C., Damping-off of Vegetable and Ornamental Seedlings, III, 379.
- Srivastava, H. C. and P. B. Mathur, Effect of Terpeneol in inhibiting the Sprouting of Potato Tubers during Storage, III, 375.
- Srivastava, H. C., P. B. Mathur and K. Dripal Singh, Studies on the Cold Storage of Mangosteen (*Garcinia mangostana*), III, 378.
- Srivastava, H. C., Damping-off of Vegetable and Ornamental Seedlings, III, 379.
- Srivastava, H. D. and S. C. Dutt, Biological studies on *Schistosoma indicum* Monotomomy, 1906,—a common blood-fluke of Indian ungulates, III, 353.
- Srivastava, H. D. and C. T. Peter, On Five New Species of Amphistome Cercariae from India, III, 353.
- Srivastava, H. D. and K. N. Mehra, Studies on the life history of *Moniezia expansa* (Rud., 1810), a broad tapeworm of ruminants, III, 352.
- Srivastava and S. C. Dutt, Biological studies on *Orientobilharzia dattai* (Dutt &

- Srivastava, H. D. and K. N. Mehra, Studies on the life history of *Ascaris vitulorum* (Gocze, 1782), the large intestinal roundworm of bovines, III, 354.
 Srivastava, 1952)—a blood fluke of domestic mammals, III, 351.
- Srivastava, H. D. and S. C. Dutt, Life history of *Schistosoma indicum* Montgomery, 1906—a common blood-fluke of Indian ungulates, III, 354.
- Srivastava, H. D. and P. G. Deo, Studies on the effect of multiple primary infections upon a subsequent infection of *Ascaridia galli*, Schrank, 1788, in Chickens, III, 346.
- Srivastava, H. D. and S. C. Dutt, Toxicity of certain chemicals to the miracidia and cercariae of *Schistosoma indicum* and *Orientobilharzia dattai*, III, 351.
- Srivastava, P. N. and P. Bhattacharya, Studies on deep freezing of buffalo semen, III, 248.
- Srivastava, S. C. and M. B. Lal, Reaction of Arachnid cuticle to some Chemical Reagents, III, 388.
- Srivastava, H. M. L., *Abopheles Culicifacies* as Urban Vector of Malaria in U.P., III, 335.
- Srivastava, S. C. and M. B. Lal, On some peculiarities of the Cuticle of Indian Myriapods, III, 286.
- Srivastava, H. D. and S. C. Dutt, A revision of the genus *Ornithobilharzia* Obhner, 1912, (Trematoda : Schistosomatidae), III, 283.
- Srivastava, H. D. and C. T. Peter, *Cercaria ratnagiriensis*, N. Sp., A Megalurous Cercaria from *Paludomus obesa* (Philippi), III, 284.
- Srivastava, K. M., A New Post-Harappan Ceramic Ware in Saurashtra, III, 321.
- Srivastava, H. C., Studies on Tumour Disease of *Coriandrum Sativum* L. caused by *Protomyces Macrosporus* Unger, III, 218.
- Srivastava, H. C., Viability of the Chlamydospores of *Protomyces Macrosporus* Unger, III, 218.
- Srivastava, K. P. and S. K. Pande, On a New Species of *Cephalozia* Dum. from Pachmarhi, Madhya Pradesh, III, 222.
- Srivastava, H. D. and P. G. Deo, Studies on the biology and life-history of *Ascaridia galli*, Schrank, 1788, III, 282.
- Srivastava, H. D. and S. C. Dutt, Studies on the Life History of *Orientobilharzia Dattai* (Dutt & Srivastava, 1952) n. comb.—a blood-fluke of domestic mammals, III, 350.
- Srivastava, Narendra Prasad and Ram Das Tiwari, Cannizzaro Reaction and Crossed Cannizzaro Reaction with Naphthaldehyde, III, 128.
- Srivastava, C. M. and S. R. Khastgir, The Streamer Mechanism and the Sparking "Threshold", III, 30.
- Srivastava, R. C. and R. P. Rastogi, Non-equilibrium Thermodynamics of Thermal Transpiration of N_2O_4 .
- Srivastava, Pramila, On Strong Rieszian Summability of Infinite Series, III, 5.
- Srivastava, B. N. and S. C. Saxena, Semi-empirical formulae for the Thermal diffusion factor of mixtures with one invariable constituent, III, 36.
- Statistical Method in Genetics and plant Breeding, IV, 37.
- Structural Physiology of the Cytoplasm, IV, 88.
- Subrahmanyam, V., Bhagwan S. Lulla and Dyal Singh Johar, Development of Amylase under submerged cultivation of *Aspergillus Oryzae*, III, 144.
- Subrahmanyam, S. and A. P. Madhavan Nair, Studies on the low temperature carbonisation of South Arcot lignite and on the properties of the products obtained, III, 152.
- Subrahmanyam, V., Bhagwan S. Lulla and Dyal Singh Johar, Production of Fungal Diastase, III, 143.
- Subrahmanyam, V., Bhagwan S. Lulla and Dyal Singh Johar, Production of Fungal Distase, III, 143.
- Subbaratnam, N. R. and A. K. Bhattacharya, The Problem of Enhanced Light Absorption in the Ultraviolet in Iodine Reactions, III, 91.
- Subbhadramma, G. V., Some Studies in Random Fading of Radio Signals, III, 24.
- Sundararajan, E. R. and T. Chandrasekharaiya, The Spurt in the Expectation of Life in Mysore State, IV, 2.
- Suwal, P. N. and S. P. Pathak, Comparative study of fats from mature (mother) and immature (embryo) shark (*Galeocerdo Tigrinus*) liver oils, III, 159.
- Synthesis of Steroids, IV, 68.

T

- Tikoo, P. K., A Thermionic Analogue of Joshi Effect in Nitrogen, III, 31.
- Tikoo, P. K., Influence of the Nature of the Electrode Material on Joshi Effect in Nitrogen, III, 31.
- TiKotkar, N. L. and S. N. Kulkarni, Substituted Quinoline Acetic Acids, III, 114.

- Tilak, B. D. and V. V. Ghaisas, Thiophene Isosters of Carcinogenic Hydrocarbons, III, 114.
- Tilak, B. D. and R. B. Mitra, Synthesis of a Thiophene Analogue of 3-Desoxyequilemin, III, 121.
- Tiwari, Ram Das and Narendra Prasad Srivastava, Cannizzaro Reaction and Crossed Cannizzaro Reaction with Naphthaldehyde, III, 128.
- Talati, A. M., Studies on Parachor, Part I, III, 95.
- Talati, A. M., Studies on Parachor, Part V, III, 96.
- Talati, A. M., Studies on Parachor, Part III, 95.
- Talati, A. M., Studies on Parachor, Part IV, III, 96.
- Talati, A. M., Studies on Parachor, Part II, III, 95.
- Talpade, C. R. and K. Z. Patil, Role of Inductomeric effect in the decomposition of Diazonium Chlorides, III, 105.
- Tamlane, R. V. and S. J. Lote, Soils Hills, III, 366.
- Tandon, H. P., S. Bose and S. G. Iyer, Experiments with Built up Litter for Raising Chickens, III, 343.
- Tandon, J. N. and G. N. Gupta, Essential Oil of Ajowan Seeds and herb, III, 167.
- Tandon, H. P. and S. G. Iyer, Influence of Body Weight of Pullets on Fecundity, III, 345.
- Tandon, H. P., S. Bose and S. G. Iyer, Studies on the Utilisation of Vitamin B₁₂ and Antibiotics in Poultry Feed, III, 344.
- Tandon, H. P., S. G. Iyer and S. Bose, Studies on Up-grading of Indian Poultry, Tandon, H. P., S. G. Iyer and S. Bose, Economics of Different Breeds with Reference to Eggs Production, III, 344.
- Tawde, N. R. and B. S. Tatil, Rotational temperature lag in CH (4315) and CH (3900) bands in a Flame, III, 27.
- Tawde, N. R. and G. K. Mehta, Estimation of Electron Energy in H. F. Discharge in H₂, Part I—Probe Method, III, 29.
- Tawde, N. R., M. V. Shingre and D. D. Desai, Transition Probabilities in bands of Blue-green system of TiO by numerical integration methods of Bates and of Pillods, IV, 5.
- Tawde, N. R. and V. Rajeswari, Swan Bands in Rare Gases : Part I—Some peculiar features of the Development, III, 28.
- Tawde, N. R. and P. V. Chandratreya, Anomalous temperature of TiO bands in carbon arc, III, 28.
- Tawde, N. R. and P. V. Chandratreya, A case for the fixation of internuclear separation (A) in E², x E² levels of La^{III} from intensity characteristics, III, 28.
- Tawde, N. R. and V. Rajeswari, Swan Bands in Rare Gases : Part II—Role of the nature of rare gas and its pressure in transition probabilities, III, 29.
- Tawde, N. R. and G. K. Mehta, Estimation of Electron Energy in H. F. Discharge in H₂, Part II—Spectroscopic Method, III, 29.
- Tawde, N. R. and K. S. Korgaonkar, Influence of Oxygen and Air on the Intensity Distribution among the Bands of N₂ second Positive System, III, 27.
- Teaching of Agriculture, IV, 114.
- Teaching of Mathematics in Engineering Institutions, IV, 28.
- Teaching of Physiology in India, IV, 122.
- Tembe, V. B. and Miss F. S. Shaikhmahmud, Maturation in *Parapencopsis stylifera* (Crustacea), III, 287.
- Tewari, Ram Das and Purna Chandra Gupta, Chemical Examination of the Colouring matters from the seeds of *Cassia-tora*, III, 142.
- Textile Chemistry, IV, 61.
- Thakare, K. R. and E. S. Narayanan, Confirmation of the Number of Larval Instars in the Genus *Bracon* by the Application of Dyar's principle, III, 299.
- Thakare, K. R. and E. S. Narayanan, Studies on the Immature Stages of the Genus *Bracon* and the Genus *Stenobracon* (Hymenoptera : Braconidae), III, 298.
- Thakare, K. R. and E. S. Narayanan, Bionomics and Biology of *Chelonus narayani* Sp. Nov. (Hymenoptera : Braconidae), an Egg Larval Parasite of the Gram Caterpillar *Heliothis armigera* (Fbr.), III, 297.
- Thakor, V. M. and Miss D. B. Jhaveri, Fiedel Crafts reaction on Peonol and Monomethyl ether of Methyl-B-resorcyate, III, 126.
- Thakor, V. M. and Miss D. D. Vaghani, Condensation of aniline with ethylacetate, III, 124.
- Thakor, V. M. and S. B. V. Rao, Successful Chemotherapy of Avian Pasteurellosis with Sulphamezathine, III, 246.
- Thakur, B., Study of Oil Gas Tar, III, 171.
- Thiagarajan, T. R., Differentiation and Dedifferentiation in Yeasts, III, 246.
- Tondon, S. K. and Shanti Sarup, Root System of *Gynandropsis pentaphylla* DC, III, 241.
- Tonpi, K. V. and P. J. Deoras, Some External Insect Parasites of Rats in Bombay, III, 289.

Transformers and their Applications, IV, 21.
Tribal Welfare and Rehabilitation, IV, 96.

U

Udupa, H. V. K. and B. B. Dey, A Nel Technique in Electrolytic Practice, IV, 6.

V

- Vaghani, (Miss) D. D. and V. M. Thakor, Condensation of aniline with ethylacetate, III, 124.
Vaidya, P. C., Reformulation of the Field Equations of the Unified Field Theory, III, 8.
Vaish, K. N. and J. R. Saraf, pH determination of Iodic acid solutions, III, 36.
Varde, (Miss) M. R., (Miss) P. D. Nayak and D. V. Bal, The Air-bladder and its Relation with the Auditory Organ of *Ilisa toh*, III, 302.
Varma, A. S., K. K. Jha, R. Singh and H. N. Mukherjee, Studies on Ammonification and Nitrification in Bihar soils in relation to soil conditions, III, 367.
Verma, P. S. and Sunil Kumar Mukherjee, Studies on the varietal classification and virus resistance in lady's finger (*Abelmoschus Esculentus* Linn), III, 371.
Varma, M., Space Errors in Relation to Manuscript Slant, III, 406.
Varma, A. S., S. C. Mandal and H. N. Mukherjee, Mineral of plants and its relation to the synthesis of ascorbic acid, III, 377.
Vasavan, A. G. and R. Venkataraman, Studies on the Use of Crushed Salt for Fish curing, III, 306.
Vasavan, A. G., R. Venkataraman and A. Sreenivasan, Drying of Fish with Infra-red Lamps, III, 306.
Vasil, I. K. and B. M. Jorhi, Studies in Pollen Germination, III, 260.
Vasil, I. K., Morphology and embryology of *Rhretia laevis* Roxb, III, 239.
Venkataraman, R. and A. Sreenivasan, Marine Denitrifying Bacteria—with a Description of New Species, III, 313.
Venkataraman, R. and A. Sreenivasan, Utilisation of Various Nitrogenous Compounds by certain *Pseudomonas* Cultures from Marine Environments, III, 314.
Venkataraman, R. and A. Sreenivasan, Bacteriology of Off-shore Marine Environments (Pearl Banks) off Tuticorin, III, 314.
Venkataraman, R. and A. Sreenivasan, Effect of Sewage Effluents and the Coliforms on Sea water, III, 313.
Venkataraman, R. and A. Sreenivasan, Spoilage of Commercially Canned Fish, III, 306.
Venkataman, R. and S. T. Chari, Amino Acid composition of Marine Fish Proteins, III, 305.
Venkataraman, R. and A. Sreenivasan, The Bacterial Flora of Shark, III, 305.
Venkataraman, R. and A. G. Vasavan, Studies on the Use of Crushed Salt for Fish curing, III, 306.
Venkataraman, R., A. G. Vasavan and A. Sreenivasan, Drying of Fish with Infra-red Lamps, III, 306.
Venkateswarlu, J. and L. Lakshminarayana, Contribution to the embryology of *Hydrocera Triflora* W. & A., III, 236.
Venkateswarlu, J. and B. Atchutaramamurtu, Contribution to the Embryology of two *Boraginaceae*, III, 237.
Venkateswarlu, D., N. K. Roy Chaudhury and S. V. L. N. Rao, Extractives of South Arcot Lignites, III, 166.
Venkateswarlu, D. and I. B. Gulati, Submerged Combustion, III, 414.
Venkateswarlu, D., Pressure Drop in Heat Exchange, III, 414.
Venkatesh, C. S., The poral dehiscence of anthers in *Polygala*, III, 238.
Verma, K. T., Rama and R. P. Rastogi, Thermodynamics of solutions of mixed electrolytes, III, 102.
Verma, Gyanendra and B. Sen, Studies on the Pollen Grains of Crop Plants—Maize (*Zea Mays*) II. Effect of Ovule and Silk Extracts, Calcium Nitrate and Phenoxy Compounds on the Elongation on Pollen Tubes, III 261.
Verma, Gyanendra and B. Sen, Studies on the Pollen Grains of Crop Plants—Mustard (*Brassica campestris* var. Yellow Sarson Prain.) and Garden Pea (*Pisum sativum* L.), III, 262.
Verma, Gyanendra and B. Sen, Effect of Presoaking Chilling Seeds of Mustard T 102, and Wheat Pb. 228 in Different Inorganic Media, III, 262.
Verma, D. K. and B. Sen, Estimation of Amino-acids in the Vernalisable and Non-Vernalisable Strains of Wheat, III, 263.

- Verma, R. and M. Pathak, Soil, its erosion and conservation in the Sadar sub-division of Ranchi, Bihar, III, 208.
- Verma, Raghuji, A Study of Granites and Gneisses of the Auranga-Koel-Valley, Palamau, Bihar, III, 188.
- Verma, M. R. and Y. P. Singh, Estimation of Arsenic or Antimony in presence of Copper, III, 80.
- Verma, M. R. and Ramji Dass, Two Dimensional paper Chromatographic method for Detection of Phenols in Bitumen, III, 80.
- Verma, M. R. and V. M. Bhuchar, Volumetric method for iodimetric Determination of Vanadium, III, 80.
- Verma, R. and A. P. Jain, The Petrography of the Granites and Associated Khondalitic Rocks near Ranchi, Bihar, III, 187.
- Verma, Raghuji, A Preliminary Note on the Sheared Zone of the Auranga-Koel-Valley, Palamau, Bihar, III, 194.
- Verma, M. R. and S. D. Paul, Spot-test method for the detection of cadmium in presence of copper, tin and lead, III, 80.
- Verma, Raghuji, Petrography of the Ultrabasic Intrusives of Auranga-Koel Valley, Palamau, Bihar, III, 186.
- Verma, M. R. and K. C. Agarwal, Estimation of Boric acid in Nickel-plating Baths, III, 80.
- Verma, M. R. and S. D. Paul, Volumetric method for the Determination of Zirconium, III, 80.
- Vishni, P. N., P. S. Mene, V. R. Sohoni and Y. G. Sathe, Battery grade MnO_2 from M. P. manganese ore by Chemical treatment, III, 173.
- Vishnoi, H. S., Some observations on the mounds of the termite *Odontotermes obesus* (Rambur) (Isoptera), III, 291.
- Viswanathan, T. S., J. C. Ghosh and M. V. C. Sastri, Reaction in the substrate formed on a Cobalt Fischer-Tropsch catalyst, III, 104.

W

- Wadhwa, Y. D., Boundary Layer for a Parabolic Cylinder, III, 11.
- Werner, G. and K. L. Mukherjee, Biological Effect of Macromolecular substances, III, 394.
- Wagh, R. V., On the Gravitational Field of an Isolated Fluid Sphere, III, 37.
- Wagh, R. V., On some Spherically Symmetrical Models in Relativity, III, 8.
- Wakhaloo, S. N., A study of the granites of Jabalpur (Madhya Pradesh), III, 204.

X

- Xavier, J., Amiya Kumar Chakrabarty and Priyadarajan Ray, A Critical Review of the Methods for the Colorimetric Estimation of Palladium, III, 76.
- Xavier, J., Amiya Kumar Chakrabarty and Priyadarajan Ray, A Critical Review of the Methods for the Colorimetric Estimation of Chromium, III, 75.
- Xavier, J., Amiya Kumar Chakrabarty and Priyadarajan Ray, A Critical Review of the Methods for the Colorimetric Estimation of Titanium, III, 77.

Y

- Yeddanapalli, Lourdu M. and V. V. Gopalakrishna, Autoxidation of the Monophenol from Commercial Cashew Nut Shell Liquid and of its Methyl Ether, III, 131.
- Yaseen, Mohaddem, A few observations of the Effect of Colchicine on the root cells of Castor (*Ricinus communis*), III, 373.
- Yeddanapalli, Lourdu M., R. Ganesan and N. S. Gnanapragasam, Halogenation of Phenol with Iodine Bromide in Acetic Acid, III, 111.

Z

- Zaheer, S. H. and M. B. Naidu, Laboratory and field tests for the control of *Eupterote mollifera*, III, 292.

- Zaheer, S. Husain and Baldev Singh, Condensation of s-dichloroacetone with phenol and its ethers, III, 133.
- Zaheer, S. Husain and G. S. Sidhu, Addition of Iodine 3,5-dinitrobenzoate to Terpenes, III, 133.
- Zaheer, S. H. and I. K. Kacker, Reaction of Phenylmagnesium bromide with 3-Phenyl-4 (3H)-Quinazoline, III, 121.
- 4-phenylpiperidine hydrobromide, III, 131.
- Zaidi, S. T. H., C. N. Gupta and Ganesh Chandra, Dill seeds and herb oils, III, 167.
- Zahidov, T. Z., Main trends of fauna investigation in Uzbekistan, IV, 12.

